Paving and Municipal Engineering

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SEWAGE DISPOSAL.

THE methods of sewage disposal, where there is a system of sewers existing, may be divided into four general heads.

1. Discharge of the crude sewage into the water courses, lakes, harbors, etc.

2. Chemical precipitation of the insoluble and also a small percentage of the soluble constituents of sewage.

3. Purification by broad irrigation.

4. Purification by intermittent downward filtration, hitherto generally preceded by natural or chemical precipitation.

The first method of discharging the sewage, in its crude condition, is still almost the universal one in use in this country where our streams and lakes are on a large scale, and where the sewage generally becomes at once largely diluted. In England, with its dense population, and small streams, the conditions are different, and the progress of sanitary science has compelled the adoption of some method of purification of sewage in order to relieve its rivers and streams of pollution. In the more densely settled portions of our country, notably in Massachusetts, the need of restraining power to prevent the pollution of streams has also been felt, and authority given to State Board of Health to control this matter. Authorities differ considerably as to the dilution which is necessary for crude sewage in a running stream. Probably with ordinary American sewage, which is not near as rich as in England, where there is much less waste permitted in the water supply, a dilution of 1 in 20 is sufficient. It is better to express it in terms of the number of inhabitants, and it may be said that, if a river is not used below for a water supply it may receive the sewage of 1,000 persons for

every 150 to 200 feet of minimum flow per second; if natural subsidence takes place soon after entering the stream it will not then be offensive to towns a few miles below or be destructive to fish. This is equivalent to a flow in the river of 1,600 to 2,100 gallons per day for each inhabitant. In the recent report on the improvement of the sewerage of Washington (Messrs. Hering, Gray & Stearns) it is stated that different authorities give a range of dilution necessary from about 970 to 2,130 gallons of flow per day per inhabitant. For Chicago a dilution was recommended, for its new drainage scheme, now under construction, of four cubic feet per second for 1,000 persons—nearly 2,600 gallons per day for each person.

It is of the first importance when crude sewage is turned into neighboring bodies of water, and, as well, when it is delivered at a station for preliminary treatment by precipitation or irrigation, that it should be removed promptly and discharged or treated without delay, before any offensive putrefaction has commenced.

CHEMICAL PRECIPITATION.

The principal agents used in chemical precipitation are:

1. Lime only.
2. Salts of alumina—generally used in connection with lime.
3. Salts of iron, sometimes combined with alumina, and in conjunction with lime.

Chemicals do not do much more than clarify the sewage, giving a more or less clear looking effluent, which still retains a large proportion (at least three-fourths) of the soluble organic impurities. Still, if this effluent is discharged into a running stream of sufficient minimum flow, much less than is needed for crude sewage—no nuisance will arise, and all reasonable requirements will be satisfied if the water is not to be used farther down stream for domestic purposes. As this principal function is to clarify the sewage, the amount of chemicals should be kept as low as possible to diminish the amount of sludge, often so difficult to dispose of, as well as for other reasons; and particularly the use of large quantities of lime should be avoided. Excess of lime is more injurious on account of producing more putrescible compounds. Sulphate of lime in lime sludge, if the latter is stored for any length of time, is likely to decompose and evolve sulphureted hydrogen and thereby create a

serious nuisance. Moreover, an alkaline effluent mixing with the organic matters already in the mud of many rivers, is likely to produce very offensive putrefaction. A notable example of this was at Leicester, England, when the lime process had to be superseded or supplemented by irrigation.

The action of the chemicals as described by Dr. Tidy, an eminent English sanitarian, is as follows:

A portion of the lime is converted into carbonate of lime and serves as a weighting material to help settle mechanically the lighter floculent suspended matter, very important because it is that ingredient in the sewage which readily putrefies. A second portion combines with some of the organic matter in solution, making an insoluble precipitate. And if an alumina salt is also used, a third portion of the lime makes the sewage alkaline, in which condition the alumina will be precipitated and combine also with some of the dissolved organic matter not reached by the lime in an insoluble form. Dr. Tide, while considering iron compounds as valuable precipitants, objects to them on account of their tendency to blacken the water of the river into which the effluent is discharged.

Lime is usually applied in the form of milk of lime, and as where this is the only agent used it usually requires about one ton of lime for every million gallons of English sewage, a very large amount of sludge is produced. I would state here that in English practice one ton always means 2,240 pounds, and that an English gallon is about one-fifth larger than our own; and repeat that their sewage is much less diluted with water than is common in America. The tendency is to diminish the amount of lime, and Dr. Tidy gives as a minimum ten grains of lime per gallon, when the sewage does not exceed thirty gallons per head—which is only about two-thirds of the previously mentioned quantity. An addition of one-third grain per gallon of chloride of lime is said to prevent the growth of sewage fungus, which sometimes give much trouble.

There are several disposal works still in England, which use lime exclusively for precipitation. I found in many cases alumina-ferric substituted for the simple sulphate of alumina. It contains a small percentage of sulphate of iron with the sulphate of alumina (alumina soluble), 14 per cent.; peroxide of iron, 0.75 per cent.;

sulphric acid, 3.18 per cent.; water, 51.44 per cent. The alumina-ferric is very soluble.

A plain salt of iron, copperas (or proto-sulphate of iron) is also used in conjunction with lime, as will be explained in connection with the London disposal works.

The original A B C process, so named from its principal constituents, alum, blood and clay, had originally quite a number of ingredients, the main one of which was charcoal. The use of blood and the union constituents have, however, been abandoned, and the mixture now ordinarily consists of alum, clay and charcoal, as the refuse from prussiate of potash works. It is claimed that it deodorizes as well as precipitates. Such large quantities of chemicals have to be used by this method, varying from 28 grains per gallon at Leicester in 1868 to 224 grains per gallon, that an unusual amount of sludge makes an excellent manure, much more valuable than the ordinary product. It certainly seems to meet with a ready sale and at a much higher price after the special treatment it receives. Dr. Tidy characterizes this process as giving the best effluent. More details of this process will be given in describing the works at Kingston-on-Thames.

There remains the Webster electric method. This method seems to be of some value; so far as I can learn, it has not passed the experimental stage, but has not been adopted by any town for the treatment of its sewage. The action of the electric current is to decompose water and chloride existing in the sewage, thereby liberating at the positive pole chlorine and oxygen; and "these elements being liberated in a reascent state they are in a condition in which they are intensely active, so that the organic matter in the sewage is rapidly oxidized into innocuous forms." The electrodes are made of cast iron of the commonest quality, and the inventor claims that if made of the weight he proposes, they would last for ten years. The sewage has to be first screened in the usual way, and after electrical treatment turned into settling tanks, the same as when chemicals are used. It is claimed that at Clossness, the effluent contained only three grains per gallon of suspended matter, consisting almost entirely of oxide of iron, and which could be removed, if necessary, by filtering through a few inches of sand; and that from 61 to 87 per cent. of the organic matter in solution was

also removed. In regard to cost, the estimate given by Mr. Webster requires 26 horse-power for 24 hours to treat a million gallons, and a waste of 286 pounds of iron. I made several efforts in London to find out something directly about this method, but could not learn that even any experiments were in progress at that time, and finally hearing that Mr. Webster had become insane, I gave up the investigation.

As the sewage flows into the works, lime (generally in the form of milk of lime) is run into it in the proper proportions, and thoroughly mixed with it by baffle boards or mechanical mixers. If a second ingredient is used it is run, after its solution in water or in some of the sewage itself, into the stream of sewage a little distance beyond the previous admixture, whence it flows directly to the settling tanks.

These tanks are always several in number in order to allow of cleaning them of sludge, and are worked either upon *continuous* or *absolute rest* system. By the latter method a tank is filled with the sewage and allowed a certain length of time of undisturbed rest for precipitation. In some instances this is effected in a single hour, but more commonly two hours are given. When the sludge is sufficiently precipitated the supernatant clarified sewage is drawn from the surface by a radial floating arm; the rate of flow is regulated by a steam valve at the lower fixed end of the arm, and the hollow cylindrical float at its upper end keeps the orifice of discharge, at this end of the arm, about nine inches below the surface. The water is thus drawn off to the vicinity of the sludge without disturbing it. With two hours rest the tankage capacity is ordinarily about 50 per cent. of the daily flow.

By the continuous system the sewage enters one end of the tank and flows slowly to the other end, where the clarified water passes over a wire in a thin sheet. Cross walls are sometimes inserted, over the top of which the partially clarified sewage flows from one division to another; and floating scum boards are necessary to prevent any floating substance from flowing off over the wire at the lower end. The sewage is from two to five or even six hours in passing through the settling tanks. With the continuous system a tank may be in use for several days, or even a week, before it is necessary to stop the flow and clean out the sludge. If, however,

they are allowed to run more than three days there is danger of decomposition taking place in the settled sludge and evolving foul gases, principally carbureted hydrogen or marsh gas. This throws to the surface large masses of the sludge which settles again slowly, or is forced down by hand. The effect of this is to cause the sewage to become very foul, as the lightest and most offensive matters are the last to settle and first to rise, and are also nearest the outlets.

In many modern plants the sewage after leaving the tanks is made to fall over a series of steps to aerate it. If the clarified sewage is to pass through filter beds, the oxygen thus absorbed is of value in assisting the inoffensive destruction of the organic matter in solution by nitrifying bacteria, and if turned into a stream its alkalinity will be partly neutralized by the carbonic acid thus derived from the atmosphere. Small coke filters are sometimes added at the outlet, but their value is very questionable. The bottoms of the tanks slope to the outlet valve through which the sludge is discharged, the discharge being assisted and the tank cleaned by men armed with large squillgees. Sometimes this sludge is simply run out into pits and sold or given away. It is generally very difficult to dispose of it in this bulky form, containing 90 per cent. of water, even by paying for carrying it off. A better method is to pass it through filter presses by which the water is reduced from 90 per cent. to 50 per cent. and the bulk of the sludge reduced to one-fifth of its former dimensions. In this solid and compact form it has about the same value as farm yard manure, and except in the vicinity of London, where it has to compete with the immense amount of stable manure that has to be got rid of somewhere, it can easily be disposed of for the hauling, and frequently some return obtained in cash.

In some cases the sewage flows by gravity into the "montejus," as the sludge receivers are technically termed, but in many others the sludge is lifted into these montejus by exhausting the air from them, or again forced into them by pumps. When a montejus is filled with sewage compressed air (60 to 100 pounds per square inch pressure) from the air pump is turned into the top and the sludge forced out into the filter press; when the montejus is emptied the compressed air still in it is turned into the top of another filled montejus till the pressure in the two is equalized. The balance of

the air in the empty one is usually wasted. Pumps are sometimes substituted for compressed air. The montejus is discharged through a pipe which reaches nearly to its bottom, into the filter press. This consists of a number of cast iron disks, generally circular, with a hole through their center and with a series of concentric grooves and a few vertical ones on each face, so hung that they can be moved backwards and forwards, in a vertical position, on supporting bars and screwed by a hand wheel into close contact. Two pieces of flax canvas are placed between each pair of disks before screwing them up. The sewage enters through the central hole between the sheets of canvas of each pair of disks and the liquid portion passes out through the meshes and by the grooves to an outlet below.

The waste from the sludge presses is turned back into the inlet sewer to pass through the tanks again. About one hundred weight of freshly ground chalk lime is added to the sludge as it enters the montejus for every ton of the compressed cake. With good lime the complete operation of filling the montejus and making the sludge cake can be performed in forty-five to fifty minutes. In English practice about eight tons of sludge cake are made per 1,000 persons. One thirty-six inch machine with twenty-four circular plates will provide for 12,000 persons, working by day only.

In a few cases the sludge has been burned in furnaces or garbage cremators without passing through a filter press.

BROAD IRRIGATION AND INTERMITTENT FILTRATION.

Although the effluent, after chemical precipitation, is sometimes further purified by land irrigation or filtration, yet by either of these methods fresh crude sewage may be applied directly to the land, first passing it through a coarse screen to retain any very coarse or foreign matter. If the sewage has to be pumped, as is generally the case, the churning action of the pumps will break up the more solid matter quite thoroughly; when pumped the screens should, of course, be inserted between the pumps and the sewer leading to them. The sewage, as applied to the land, is diluted as little as possible with rain water.

There is no question that either of these modes of treatment is much superior to chemical precipitation in the character of the effluent obtained, where the conditions are favorable. But broad

irrigation requires a large area of farming land, which it is frequently impossible to obtain near a large city, and if it is of a heavy clayey character, with a tendency to crack in dry weather, great care and judgment must be used in the under-draining or the results will be exceedingly unsatisfactory, instanced by the first attempts at irrigation in Wimbledon, England. The volume of the sewage, too, is unfortunately generally greatest when it is of the least service to the land in raising crops. With broad irrigation it is generally assumed that an acre will purify the sewage of 100 persons only; and when the sewage is to be applied so as to utilize the land to the best advantage for the crops, the number allowed per acre should be, according to various authorities, but 30 to 50. With the sewage of 100 persons to an acre its volume is often too large to admit of growing cereals, the principal crops being rye, grass, mangel-wurzel and osiers. The volume of sewage that can be applied to different growing crops varies enormously, in one cake, from 17,500 tons per acre for rye grass to only 188 tons for beans. A good many of the grains and small vegetables that are grown on English sewage farms, are, in many cases, not flowed with sewage during the period of growth. Even ten years ago broad irrigation was used for fifty towns in Great Britain, combined, in some cases, with previous precipitation. It is used to a considerable extent in Paris, and the system is being extended with the intention of ultimately purifying all of its sewage. And Berlin, with its population of about 1,600,000, disposes of nearly all of its sewage in this way.

Intermittent downward filtration requires much less area, but to be successful an open, sandy soil is needed, the more near it is to pure sand and gravel and the more free from any covering of loaming soil, the better; and such land is frequently not obtainable within a reasonable distance, if at all.

Rawlington formerly stated that the sewage of 500 persons would be disposed of per acre by this method if chemical precipitation were first applied. But recent English investigations and the more complete and thorough experiments on a larger scale at Lawrence, Mass., under the direction of Hiram F. Mills, C. E., demonstrated that with a proper soil one acre will purify the sewage of 1,000 per-

sons, and possibly even more, ten times as much as by broad irrigation, and this without any previous precipitation.

The preference for this method has been given in England to certain farming soils on which crops can be raised, necessarily considerably more limited in variety than with broad irrigation, on account of the vastly greater doses of sewage that are applied. But from our own more thorough experiments, showing the greater value of sand and gravel entirely free from loam, the expediency of any attempt at cultivation of crops is very questionable. They certainly are not in the least needed for the purification of the sewage.

In intermittent filtration and in broad irrigation as well conversion of organic substance into ammonia and ammonical compound, and their further reduction into inert and harmless inorganic material, the nitrites and more especially the nitrates, is a purely biological process, being accomplished by the agency of living organisms, the bacteria. And, in order that these nitrifying bacteria may be able to multiply and do their work, they must have an abundant supply of oxygen. Hence the sewage must be applied intermittently in order to allow it to disappear from the surface and the air to enter the soil after each charge, and the soil must be open and porous, with the coarse material on top, for the same reason. Without a proper supply of oxygen the destruction of organic matter is caused by putrefaction (another biological process) with the liberation of the foul smelling gases (sulphureted and phosphoreted hydrogen) while the work of the nitrifying bacteria is accomplished with entire freedom from bad odors.

With filtering areas five or six feet in depth not only are the organic compounds nearly all destroyed but the bacteria themselves disappear, but few being left in the effluent; in some cases even less than in our best drinking waters. And, although it is not wise to trust too implicitly to its effect on the pathogenic (or disease producing) bacteria, yet it is probable that very few would escape through a well regulated filter of this character.

It takes some time for a filter bed to attain its regimen; *i. e.*, for the microbes to have been sufficiently cultivated to thoroughly nitrify the full amount of sewage which the particular soil will permit. The said grains of the filter become coated, more or less completely, for a considerable depth with a form of bacterial jelly known

as mucoderan or Zoogloea, and it is probable that the filter is ineffective until this Zoogloea has begun to form. It is quite necessary, moreover, that the application of sewage be made regularly, without long intermission, in order that the regimen of the bed be maintained.

The first experiments on the application of intermittent downward filtration to sewage were made about the year 1870, and were on rather a small scale, a glass cylinder 6 feet long and only 10¼ miles in diameter being used and 5 feet of the soil to be tried being put in on a drainage layer of pebbles.

The recent investigations at Lawrence, Mass., which, as Mr. Mills states, were undertaken "to learn how to purify sewage," were on a much more extended scale. Ten tanks of 16.8 inches in diameter and 6 feet high, having an area $\frac{1}{200}$ of an acre were employed, besides a number of smaller ones. These experimental tanks were thus about 195 times the area of the English ones.

To several of these tanks sewage was applied from three to six days in the week for over eighteen months, without removal of any of the surface material (as is necessary in filtration for water supplies) or even stirring up the surface. After being in thorough working order the nitrification and consequent purification was well kept up during the winter. The tanks were out of doors, but it should be said, however, that they were kept free from snow by canvas coverings, raised enough above the tanks to give free access to them. The experiments show that after nitrification is well established the temperature of the sewage may be temporarily reduced to 25 degrees and even remain at 37 degrees for two weeks without diminution of completeness of nitrification. The ordinary winter temperature of sewage in our northern climate is as high as 41 degrees to 43 degrees.

Tank No. 1 was filled with clean, coarse mortar sand. During some eighteen months of operation the surface was entirely undisturbed, and the filter received for several months as high as 55 to 400 gallons per day per acre with the result of consuming 97½ per hundred weight of the organic matter and destroying all but two-tenths of one hundred weight of the bacteria of the sewage. During the ensuing year the surface was raked over once a week to the depth of an inch, no material being removed.

The quantity then filtered was gradually increased to 102,000

gallons daily per acre, with an increase of destruction of organic matter to 98.7 per cent. The number of bacteria passing through, however, was much greater (over 12,000 per hundred centimeters.)

Tank No. 2, which was filled with fine, nearly white, sand, gave still better results during the first eighteen months during which its surface was also undisturbed, than No. 1 (only .003 of 1 per cent. of the bacteria passing), though only able to handle about 29,000 gallons daily per acre. But during the following year, when its surface was raked over weekly as in the other tank, the sewage treated rose to 60,000 gallons per acre daily and with a result for the last month of 99.7 per cent. of the organic matter consumed, and with but 17 bacteria per cubic centimeter, in the effluent; and it is doubtful if even these did not come from the pipe beneath the filter.

Still more interesting were the experiments with a filtering material composed entirely of gravel stones as large as beans, from which not only the sand had been screened but the stones washed so as to be entirely clean of sand. During the last two months of the experiment, when sewage was applied at the rate of 70,000 gallons per acre per day, 98.6 per cent. of the organic matter was converted into nitrates and more than 99 per cent. of the bacteria destroyed. This experiment is very conclusive as to the biological character of the process of destruction of the organic matter.

Antiseptics seem to be fatal to bacteria, and in the presence of a small quantity of chloroform, carbon bisulphide of salicylic acid, nitrification ceases. If the sewers are allowed to receive the sewage from chemical or even from some ordinary manufacturing works, it might prove a great hindrance to purification of sewage by this method on this account.

Some lime or other alkali seems to be necessary in the sewage to provide a base for the nitric acid formed; but not in quantity large enough to cultivate putrefaction instead of nitrifying organisms.

The warmth of the sewage is such as is discharged from the sewers as to keep the ground unfrozen in the filter beds, even in our northern severe winters, but it would seem, in order to secure their full efficiency, as if it were necessary to keep them clean of snow. No serious trouble is experienced in Guelph, Ont., from ice or snow, and in Dantzic, Germany, where the ground freezes one

to three feet in depth, the sewage does not fall below 42 degrees at point of delivery.

Unquestionably the question of intermittent filtration is the most efficient method of treating sewage, giving, when properly managed, decidedly the purest effluent.

It is almost an axiom in sanitary science, that if water has once been polluted to any extent with sewage, however the sewage may have been purified or however much it may have been diluted, the water should not be used for drinking purposes.

As indisputable as this principle may seem in theory, it does not seem attainable always in practice. Many of our western cities which are located on large rivers or lakes can not do otherwise than use them as receptacles for their sewage, whether treated in any way or untreated. And the same river or lake may be the only source from which they can obtain a water supply. It does seem in such cases that the process of intermittent filtration, when suitable ground is available, if it does not give an absolutely safe effluent, gives one safe enough for all practical purposes, especially if the river is a large one. *J. Foster Flagg.*

J. Foster Flagg. Biographical Sketch in June Number, 1893, page 319.

SIDEWALK IMPROVEMENTS IN THE VICINITY OF CINCINNATI.

The past ten years has been a period of unusual activity in village and suburban improvements in the vicinity of Cincinnati; before this period the villages in Hamilton county were but little more than country settlements, noted principally for the beauty of their location and comfortable homes; in a few of them the landscape gardener had attempted to improve upon nature, and a still lesser number could boast of palatial residences. Some of these villages had been, in olden times, stopping places for the old-fashioned stage-coach, and the inhabitants had gotten into the stage-coach way of thinking and doing; and even yet we occasionally hear some of these honored citizens bewailing the march of im-

provements and yearning for the good old days of plank roads and mud sidewalks, when the engineer was not at large to torment them with grades and stakes, and a village council knew nothing of assessments. The increase in railroad facilities and the building of new street car lines, together with the starting of new towns and villages at least made it a matter of necessity for the older towns and villages to awaken or else be left behind in the march of progress, and an intense rivalry immediately sprang up amongst these numerous rural communities, and the officials of each one became impressed with the idea "that they must do something for their town." The result has been a series of public improvements, honestly and faithfully carried out, which have made for the suburbs of Cincinnati a national reputation; and the brightest gems in the Queen City's crown are her well managed and finely improved suburban home villages.

One improvement that has contributed in no small degree to the above results has been that of better sidewalks. The improvement of village sidewalks has been a subject which has been talked about, legislated about, lawed about, discussed and cussed more than any other subject of a similar nature, until at the present day that part of the revised statutes of Ohio relating to the subject is indeed fearfully and wonderfully made, a veritable legal curiosity shop.

Believing that we, as engineers, should be thoroughly acquainted with all provisions of the laws relating to public improvements, let us review briefly the legislation upon the subject of sidewalks. The original sidewalk law of the state provided that the council of any municipal corporation might by general ordinance provide for the construction and repair of sidewalks, and if, after the passage of a resolution to construct or repair any particular sidewalk, the owner or agent of the property failed to do so within sixty days after being notified the council might order the same done at the expense of the owner, the costs to become a lien on the property the same as taxes. This law was objectionable for the reason that the owner or agent of each particular piece of property could within certain limits construct any kind of walk that might be deemed best, thus making it impossible to secure a sidewalk on any street which would be uniform the entire length, either as to manner of construction or quality of material.

This law was also hampered by another section (a section which

might be called the Weitzel law of sidewalk improvements); this section provided that "no one should be compelled to construct or repair a sidewalk who had already constructed or maintained a sufficient sidewalk." The law made no provision, however, as to who was to be the judge of the sufficiency of the sidewalk. This section, however, has been amended so that it now provides that "nothing in the proceedings shall be construed so as to tax property, for the purpose of constructing any sidewalk, the owners of which have constructed and maintained sidewalks as ordered by the council or board.

This amended section, however, does not yet fully cover the case, but it is an improvement and a step in the right direction; it should be further amended by providing that only those who have constructed and maintained sidewalks of the kind set forth in the resolution to improve shall be exempt from constructing new walks. The next legislation was in the shape of a special law of a general nature, a paradoxical expression made possible by our antiquated state constitution combined with the wisdom of our Supreme Court.

This law provided briefly that council of any village might construct sidewalks and place the cost of the same upon the general tax duplicate of the village. But one village in Hamilton county—College Hill—ever took advantage of this law; but it proved unsatisfactory and the law has become a forgotten section of the statutes.

We now reach the period in sidewalk construction when the first move was made for something better. Gravel walks were objectionable on account of the cost of keeping them in good condition, were liable to become muddy in the spring when the frost was leaving the ground and were the source of a great loss to the one who had to use them very much, in the way of shoe leather; indeed, if it be not considered a breach of professional ethics to use a pun, they were "walks that tried men's soles."

The plank walk was objectionable on account of its lack of durability as well as on account of the space underneath becoming a receptacle for filth and refuse. About this time the Schillinger patent on cement or artificial sidewalks expired and the council of the village of Winton Place made the first move for better walks by notifying the property owners on about one-half of the streets in the village to construct artificial stone sidewalks, and notwithstanding

the fact that all of these owners had already constructed and maintained gravel sidewalks as previously ordered by the council, the artificial stone walks were all constructed without any litigation.

The village of Wyoming was the next to fall into line, but profiting by the experience of Winton Place in not getting all the walks properly constructed, most of the citizens waived the right to construct the walks by private contract and allowed the village council to construct them under a general contract; yet it was impossible to construct any extended length of walk for the reason that some of the citizens having constructed gravel walks as ordered by council, refused to construct new ones.

The next village to take up the matter was Glendale, and Hon. J. C. Richardson, a citizen of that village, and a member at that time of the Ohio State Senate, secured the passage of what is now known as the Richardson Sidewalk Law. The main features of this law are as follows:

1. The law applies only to villages situated in any county containing a city of the first class.

2. The council of any such village shall, upon petition of the owners of two-thirds of the front feet of lots abutting upon any street or parts of streets, provide for the construction of said sidewalks as petitioned for.

3. The walk to be of the width and material set forth in the petition.

4. A committee to be appointed by the mayor consisting of one councilman and two of the petitioners.

5. The above committee to have estimates made, make contracts for and have entire supervision of the work and approval of all bills, but shall not receive any compensation for their services.

6. One-half of the cost to be assessed on the abutting property payable either in cash or in ten annual installments, the other half to be paid by the village at large from a tax specially levied for that purpose.

Fortunately, the committees appointed have in nearly every village operating under this law sensibly concluded to construe the law so that they could delegate their duty of supervising to an engineer. Glendale, Lockland, Reading, Norwood, Carthage, Elmwood Place, Hartwell, College Hill, Home City, Delhi, Fernbank and Avondale,

have operated under this law and owe to their new sidewalks considerable of the progress they have made as favored localities for suburban homes. Owing to the fact that considerable length of walks had been constructed in the villages of Winton Place and Wyoming prior to the passage of the Richardson law and that these walks had been paid for in cash by the owners of the abutting property it was impossible to apply the workings of this law to these villages; hence we have Sidewalk Law No. 4.

This last law is modeled after the law regulating street improvements in Hamilton county villages and Cincinnati. Council of any village is given power to order the construction of any sidewalk, to contract for and to assess the entire cost upon the abutting property, payable in cash or in ten annual installments. Under this law the village of Wyoming has constructed since June, 1892, over eleven miles of sidewalks at a cost of about $42,000. Winton Place has has also constructed walks amounting to a cost of $4,000. Adding these amounts to what has already been paid for in these villages in previous years and then adding to this the cost of work done in other villages, including Clifton, which operates under a special act, a low estimate of the cost of improvements in the last five years would be $400,000, or about twice the amount paid for similar walks in the city of Chicago in 1891.

The question of construction and of securing the best possible results is always an important one in the prosecution of any public improvement. In the construction of these sidewalks I have found that no matter how strict the specifications may be, or how carefully the contract may be drawn, two things are absolutely necessary: The contractor must be a thoroughly honest man, anxious to do the very best work, and the engineer and his inspectors must give the work constant and careful attention. The mode of construction of cement walks is no doubt familiar to the reader, but in order that some matters in connection therewith may be better explained, I give the following description from the Wyoming specifications:

1. The trenches were excavated to a depth of twelve inches and three-inch farm drain tile were placed in the bottom of the trenches in such way as to insure perfect under-drainage.

2. The foundation was composed either of clean cinders or of gravel entirely free from clay rammed to a thickness of eight inches.

3. The concrete was composed of one part of cement, two parts

of clean, sharp sand and four parts of gravel, and was three inches thick.

4. The finishing coat was composed of two parts of clean, sharp sand and one part of same brand of cement as used in concrete, and was one inch thick.

5. The work was protected by suitable covering from the weather, and sprinkled daily for one week after setting.

6. Where carriage drives crossed the walk the concrete was made four inches thick and the top coat two inches thick.

7. Only German Portland cement was allowed to be used.

8. The contractor guaranteed the work for five years.

In some of the first walks laid at Winton Place a concrete made of black diamond cement was used, and in every such case the top coat composed of Portland cement separated from it and cracked, yet the use of black diamond cement for the concrete sidewalks is endorsed by Gilmore in his work on "Roads and Streets." Profiting by this experience the specifications were changed so as to not only prohibit the use of this cement but also to compel the use of the same brand of cement in both the concrete and finishing coat. Among the many difficulties experienced in getting proper work done I have found none harder to overcome and none more serious than the carelessness of the workmen in placing the concrete and finishing coat in the walk. In ramming the concrete the sides would be rammed to the proper line while the center would be from one-fourth to one-half of an inch higher; then add to this the fact that the workman in troweling the top coating is very apt, by reason of the greater weight being exerted by his body when leaning over the center, to make this center thinner than at the sides, and we have the weakest part of the work where it is subjected to the greatest wear, in the center of the walk. To avoid this the workmen were required to use a gauge cut to the thickness of the top coat, and after the concrete was placed in the trench this gauge was drawn lightly over the same, leveling it to the proper line; it was then rammed and the top coat placed upon the same, and in order to insure the top coat being of proper thickness the straight edge used in leveling the same was slightly hollowed in the center. Another trouble encountered was the fact that the men laying the top coat, being anxious to hurry the work, would spread it the

full thickness over the concrete, and then, after leveling it, would only trowel it sufficiently to make a smooth surface on top; the result of this method is almost always that the top coat is not firmly united with the concrete and separates from it in setting, produces a hollow block, which in a very short time shows itself by the top coat cracking into pieces. To obviate this the workmen were required to spread the top coat on the concrete in thin layers, troweling it hard against the concrete and gradually bringing it up to a proper thickness.

Another difficulty was in procuring the proper kind of sand. Only sand which under a magnifying glass will show its particles to be angular and sharp, instead of round and smooth, can be successfully used. The sand must also be perfectly clean. If the particles are rounded or covered with the slightest particles of loam, in a very short time those that are at the top of the finishing coat will become separated from it by wear and break out, leaving the top surface of the walk full of small holes. While creek sand is probably the cleanest, yet sand taken from Mill creek or any rapid running stream is very apt to be composed of particles rounded smooth by the action of the water, and while some bank sand has been found in this vicinity composed of sharp angular particles, yet it is objectionable, even when free from clay, on account of containing very often vegetable matter in shape of decayed wood.

It is therefore probably a question of a short time when the use of sand in constructing these walks will have to be discontinued and a finely crushed hard stone used instead for mixing with the cement.

An objection urged against these walks has been that the blocks can not be removed and replaced, yet last summer this objection was practically answered by the removal and replacing of over fifty feet of walk, occasioned by the changing of the street grade. The blocks were carefully dug around on the sides, a way constructed of scantling was placed opposite each block, the block was then carefully lifted onto rollers and run out on the ways, the foundation was then removed, the trench lowered, the foundation partly replaced and rammed and then covered with a cushion of fine sand, the blocks were then rolled back one at a time into place, properly

lined and then gently tamped until brought to grade. But one block was broken and this through carelessness of one of the workmen. After this work was done those who had not seen it under way could not tell what part had been lowered, so carefully and well had it been accomplished.

E. F. LAYMAN.
Biographical Sketch in March Number, 1893, page 145.

Now in conclusion these walks to-day are a great improvement over any that have ever been constructed, and in point of durability, cleanliness, and cost of original construction combined are the superior of stone or brick. To say that the future may not give us something better would be to place a limit upon American skill and ingenuity.

E. F. Layman.

TESTS OF PAVING BRICK.

THE specifications for brick street pavements adopted by the city of Knoxville, Tenn., require that before brick will be accepted for paving purposes they shall be subjected to the following tests, to be conducted at two different points at the same time by competent civil engineers:

Absorption Test—The amount of moisture absorbed when the whole brick or block or pieces of same have been immersed for forty-eight (48) consecutive hours in water, shall not exceed two (2) per cent. of the weight of the sample free from moisture in air, nor more than four (4) grains per square inch of surface.

This test will be made as follows:

Five brick will be selected, two of which will be used whole, from the other three about one-third (⅓) of the brick will be broken off for use; these will then be subjected to a heat not exceeding 140° F. for twenty-four (24) hours, they will then be marked so as to distinguish them, and then the whole brick carefully measured, weighed separately and the broken pieces carefully weighed separately. They will then be placed in a vessel and covered with water at least one (1) inch, and shall so remain for forty-eight (48) hours, when they will be taken out, one at a time, dried quickly from surface moisture and weighed separately. Then upon

these data the percentage of absorption by weight and the amount of absorption per square inch of surface will be calculated. No bricks will be accepted which contain lime or other soluble substances in sufficient quantities to cause spalling or pitting of the surface when soaked in water for three consecutive days, and then exposed to the air for a corresponding length of time.

Crushing Test.—The average crushing strength of two-inch cubes taken from any part of the brick shall not be less than 16,000 pounds per square inch.

The cubes for this test will be prepared from three selected brick, as follows:

From each of the bricks thus selected there will be sawed a cube closely approximating two (2) inches, these will then be carefully rubbed down to exactly two (2) inch cubes, with parallel faces. They will then be dried at a temperature of 212° F. for three hours, then allowed to cool to the temperature of the air. They will then be tested upon a machine of sufficient capacity having a steady motion, free from jars, jerks, uneven or sudden strains, and with self-adjusting bearing surfaces. The bearing surfaces of the cubes will be protected by pieces of soft cardboard or blotting paper. Then the pressure applied. The total pressure, at the moment of spalling, and at final failure, shall then be carefully noted and recorded, and from these data the results calculated. No spalling or splitting of any consequence shall occur at a pressure of less than ten thousand (10,000) pounds per square inch.

Specific Gravity Test.—The specific gravity shall not be less than two and two-tenths (2 2-10) times that of pure distilled water at 62° F., and shall be determined as follows:

A sample of the brick shall be crushed and powdered fine enough to pass through a sieve of twenty-five hundred (2,500) meshes per square inch. Then about twenty (20) grains of powdered brick will be accurately weighed, placed in a flask and covered with pure distilled water and heated almost to boiling, then cold distilled water added and allowed to stand for six (6) hours at the temperature of the air. The flask will then be filled carefully with pure distilled water and brought to a temperature of 62° F., and accurately weighed; then emptied and refilled to the exact volume as before with distilled water and brought to a temperature of 62° F., and

again accurately weighed; then the specific gravity will be determined by the following formula:

$$S=\frac{B}{B+W-WB}$$

In which S=Specific gravity.
" " B=The weight of brick used.
" " WB=The weight of brick and water in flask.
" " W=The weight of the water and flask alone.

Concussion Test.—The resistance of the brick to concussion shall be a comparative test between the different samples, and will be made as follows:

The brick will be bedded in sand until only the upper surface remains exposed in the same position which they will occupy in the street; they will then be struck a number of blows over their entire exposed area (the same on each sample) by a two (2) pound hammer on the end of a two (2) foot arm, falling a distance of eighteen inches. The blows will be distributed evenly over the whole exposed surface of the brick, and the loss in cubic inches per square inch of exposed surface at the end of a fixed number of blows shall be calculated for comparison.

Transverse Test.—The transverse strength of the brick calculated to the modulus of rupture shall not be less than sixteen hundred (1,600) pounds per square inch, and will be determined as follows: The brick will be selected and accurately measured; they will then be placed edgewise on two supports with truly parallel edges, exactly six (6) inches apart and having a width not exceeding one twenty-fourth ($\frac{1}{24}$) part of an inch, and not less than one sixty-fourth ($\frac{1}{64}$) part of an inch, which will be rounded in form. Between the brick and these supports will be placed a soft piece of card-board to protect the brick from cutting and to insure a continuous and even bearing. Then on top of the brick a piece of card-board will be placed, and upon it and exactly half-way between the supports and exactly parallel to them will be placed a smooth and continuous bearing edge similar to the supports, care being taken to place the brick exactly at right angles to the supports and the bearing edge,

and to insure an even bearing between the brick and supports and bearing edge.

The pressure will then be applied slowly and steadily and continuously increased until fracture occurs, when the total weight will be noted and modulus of rupture calculated therefrom by the following formula:

$$R=\frac{3\,W\,L}{2\,b\,d^2}$$

In which R=modulus of rupture.
" " W=total weight required to break the brick.
" " L=length between supports in inches.
" " d=depth in inches.
" " b=the breadth in inches.

The manner of breaking and the appearance of the fractured surface shall also be noted for drawing conclusions on requirements specified in section 28.

Abrasion Test.—The resistance of the brick to abrasion, determined in the manner hereafter described, shall be such as to show a loss not exceeding .0214 cubic inch to each .155 square inch of surface on the brick.

This test shall be made by taking five of the bricks to be tested and carefully measuring and weighing them. These brick shall then be placed in a foundry tumbling barrel of not less than three feet and one inch in diameter, nor less than four feet in length. In this tumbling barrel there shall be placed three hundred and thirty (330) pounds of small rounded iron castings, none of which shall exceed seven ounces in weight. These castings shall be evenly distributed along the bottom of the tumbling barrel and on them the brick shall be laid end to end; the tumbling barrel then closed and revolved at about twenty (20) revolutions per minute until two thousand (2,000) revolutions shall have been made. It shall then be opened and the brick taken out and weighed. After this they shall be immediately returned into the tumbling barrel and it shall be closed and revolved at the same speed as before until two thousand (2,000) more revolutions shall have been made. When this shall have been done, it shall be opened and the brick again weighed,

and from the loss in weight thus ascertained the loss in cubic inches for each square inch of surface on the brick shall be calculated.

When more than one kind of brick is to be tested, each kind shall be tested by itself in the manner above described.

Another abrasion test shall be made by putting in a tumbling barrel of the same dimensions as described in section 28, G, five samples of each brick submitted for competition, and five pieces of fresh Lithonia Georgia granite, which granite will be eight and one-half (8½) inches long by three and seven-eighths (3⅞) inches deep by two and three-fourths (2¾) inches thick, with the top and bottom edges beveled to a radius of one-fourth (¼) of an inch. The brick and granite will then be placed in the tumbling barrel, end to end, on top of three hundred and fifty (350) pounds of small castings, weighing from one-half (½) pound to one (1) pound each, evenly distributed over the bottom of the tumbling barrel. Then close the tumbling barrel and revolve at a speed of about twenty (20) revolutions per minute until two thousand (2,000) revolutions are completed. The brick and granite will then be weighed separately. They will then be again returned to the tumbling barrel in the same position as before and two thousand (2,000) more revolutions at the same speed as before given them. They will then be taken out and weighed and the loss in weight of the brick shall not exceed two and one-fourth (2¼) times that of the granite, and the comparative endurance in this test will be taken into account.

STREET PAVING IN AUSTRALIAN CITIES.

[THE following article is written by the United States consul-general to Melbourne, and by permission of the State Department is published in advance of the issuance of the Consular Report in which it will appear.]

The nature of the soil of Australia made traffic over the roads of the colony extremely difficult; in the dry season they were beds of loose sand and dust and in the rainy season rivers of quicksand.

The first efforts at improvement consisted in raising the roadway from 10 to 12 inches with earth from the sides, leaving broad

and shallow ditches for drainage. Over this roadway was spread 6 inches of stone, usually basaltic in character, broken into 4 to 6 inch cubes; over this a layer of stone, broken to 2½ by 2½ inches, was spread 4 inches deep. This was "blinded" with screenings from the breaking and the whole rolled solid with a steam roller.

The roadway was about 20 feet in width, and cost for the stone alone about 4 shillings (or $1 in United States currency) per square yard, laid and rolled. These roads have been found to answer well where the traffic was not heavy or continuous; but in the leading thoroughfares in the cities not only is their maintenance very costly, but they are not satisfactory in durability.

In 1880 A. C. Mountain, M. Inst. C. E., then surveyor to the corporation of Sydney, New South Wales, in a report to that body, urged the paving of the streets of that city with wooden blocks in place of the macadamizing previously used, calling particular attention to the value of Australian hard woods for the purpose on account of their toughness and durability. Then followed a series of experiments to discover the proper foundation, the best method of laying the blocks, and the value of different kinds of wood for the purpose. King street, which is a short cross street in the busiest part of the city, was paved with eight varieties of timber, viz: Red gum *(Eucalyptus rostrata)*, black butt *(Eucalyptus pilularis)*, blue gum *(Eucalyptus botryoides)*, box *(Eucalyptus albens)*, ash *(Eucalyptus virgata)*, cedar *(Cedrala australis)*, brown pine *(Fereuela endlicherii)*, and Baltic deals. The first four were hard woods, and all were native except the last, which was from Sweden.

Owing to a fear that the hard woods would prove slippery, the blocks were laid with one-inch joints; but the width of joint has since been gradually reduced to three-eighths of an inch, without any appreciable increase of danger to horses. The foundation consisted of a layer of Portland cement concrete six inches thick, rendered on the surface with a coat of cement mortar, on which, after a week's interval, the blocks—9 by 6 by 3 inches—were placed transversely across the street, with two longitudinal rows next the curbs. These blocks, before being laid, were dipped in kerosene tar; but, as it was found that after twenty-four hours' soaking in heated tar the penetration of the tar into the hard-wood blocks was only one-

sixteenth of an inch, owing to the density of the wood, no preservative treatment was subsequently attempted.

The street thus paved was opened for traffic in August, 1880, and in March, 1882, blocks of the different woods were removed and the wear carefully measured. The red and blue gums and black butt retained almost intact their original depth of six inches, the box and the ash had been reduced about one-eighth of an inch, the cedar and brown pine about one-quarter of an inch, and the Baltic three-eighths of an inch. In 1885, the cedar, being short in the grain, had broken away rapidly, and was, with the brown pine and Baltic, replaced by hard wood, and small renewals were made of the ash and box. Except the cedar, the blocks renewed might have lasted another year, but they rendered the surface irregular.

Flinders street, in Melbourne, was paved with six-inch red-gum blocks in 1882. This street is in the busiest section of the city, connecting the railways and the wharfs, and the traffic is of the heaviest description. Blocks taken from the center of this street in 1891 showed a wear of one-sixteenth of an inch; but here, as in Sydney, all of the earlier work was done with three-quarter-inch to one-inch joints, and these were calked with a molten pitch of tar and screenings obtained from crushing stone for macadamized roads, which served the double purpose of holding the blocks firmly in place and preventing surface water from getting down to the concrete. The joint has since been reduced to five-sixteenth of an inch; and the calking is now done with properly prepared cement, as it was found that the pitch wore away and the iron-shod feet of the horses broke down the corners of the blocks, so that the road was disagreeably rough and noisy.

The streets of the principal cities of Australia having the heaviest traffic are now paved with Australian hard wood, and where proper attention has been given to the foundation and to a right selection of blocks the result has been most satisfactory. Although much of it has been down from eight to ten years and subjected to the severest test, the arch of the street is still well maintained, with an even surface, and drains practically as when first laid.

Both the climatic and traffic conditions of these cities are different from those of the cities of the United States, yet there is no

reason to suppose that the woods used here will not be equally suitable there.

It is now about six years since the first shipments were made to London of jarrah and karri for street paving. Owing to the unsatisfactory results of previous experiments with oak, elm, beech and pine, there was much opposition to their introduction, but so far they have given excellent results and are being largely adopted for the carriage way pavements of London. From *Engineering*, published in 1892, we learn that they have been put down in eighteen vestries, and that wherever the wood was laid in a suitable manner it has given the most satisfactory results. Three thousand, one hundred and sixty-seven loads, each of 600 square feet, of jarrah and karri woods were shipped to London in 1891 for street paving purposes.

In the earlier days of street paving in cities it was customary to lay the covering material upon an earth or sand foundation, but the almost invariable rule now is to lay the whole breadth of the road with a layer of cement concrete six inches deep and arched to the convexity necessary to the locality. Engineers and surveyors have for some time regarded this bed of concrete as the actual road pavement, and if durability, evenness of surface, and eventual economy be desired, of the first necessity. This cement concrete, if of good materials and carefully laid, will practically last for generations; it takes the weight of the traffic and furnishes stability to the street surface. Here, where the sandy nature of the soil gives a natural drainage and there is no frost to "lift" from below, the six-inch bed or six or seven to one cement concrete has been found to be sufficiently heavy. It is extended to the gutters, four feet wide, formed of dressed stone cubes bedded in sand, which affords the necessary expansion joints.

The half-chain roadways are of wood on concrete foundation, as before described, with wooden gutters twelve inches wide, formed of wooden blocks placed in line with the direction of the street and at right angles to the direction of the other blocks, their surface being two inches lower than the nearest street block. These and the two adjoining street blocks have three-quarter inch sand joints for expansion.

The solidity of jarrah and karri is such that some complaint is

made of their slipperiness during and immediately after slight showers of rain, but this is provided for by slightly sanding the paved streets at such times. At all other times the horse shod with a flat shoe finds as good footing as on paved streets.

It will be seen from the following figures that the first cost of thus paving a street is heavy, but the total expenditure in Melbourne in ten years for maintenance and repairs amounted to less than one per cent. on the total cost of the work.

	Per square yard.
Karri blocks 9x6x3	$2.16
Jarrah blocks 9x6x3	2.40
Six-inch cement concrete (7 to 1) and mortar rendering on surface.	1.56
Laying and grouting	.30
Excavation and removal (average 1 foot) and sundries	.30
Total	$6.72

The above cost is for blocks delivered in Melbourne, and it is probable that they could be landed in cities on the coast in the United States for the same amount.

In London karri and jarrah have worn four times as long as pine, and are still down, thus avoiding the long interruptions to traffic which occur every few years while the surface is being renewed. The scavengering can be well and quickly done, and the sanitary conditions must therefore be better. When it is necessary for any purpose to break the street, the cement concrete lends itself readily to repairs.

The government of West Australia has made a special effort to call the attention of the cities of the United States to karri and jarrah as a paving material by sending to the World's Columbian Exposition an exhibit of both woods. If possible to secure the space in some much-traveled thoroughfare, it was the intention to have a section laid with full-sized blocks and grouted joints on a cement-concrete foundation, showing how and why the cities of Australia have the smoothest, cleanest, neatest, most durable and most economical street paving of any of the cities of the world.

Geo. H. Wallace.

CURRENT INFORMATION.

COMPETITION IN ASPHALT PAVING AT THE NATIONAL CAPITAL.

WASHINGTON, D. C., June 21.—(Special Correspondence.) The Barber Asphalt Paving Company, which for twenty years has enjoyed a monopoly of paving the streets of Washington with asphalt, hereafter will have to recognize that a competitor is in the field, and to divide the profits during the coming fiscal year with the Bermudez Asphalt Paving Company of New York City. In the recent bidding contest for next year's contract, the new company was found to be the lowest bidder. When a hearing was given representatives of the two companies by the district commissioner, Mr. Worthington, appearing for the Barber Company, advanced the point that Thomas H. Thomas, the representative of the Bermudez Company, by stipulating in his contract that he would take the work at the price bid on condition that he be given 25,000 yards of asphalt to lay, had violated a provision of the law governing the making of proposals. The law, he said, provided that bids should be made for each section of pavement, to be laid separately. He also claimed that Mr. Thomas had not filed evidence that he was the authorized agent of the Bermudez Company, and that there was nothing to show that he was more than an irresponsible bidder, without experience or reputation as a contractor for the work he proposed to do. Mr. Worthington further said that if a contract were let it would be an experiment apt to lead to troublesome consequences. Thomas, he declared, had no plant for performing the work as the law required.

In reply Mr. Brown claimed that the law specifying that bids should be for separate sections of asphalt pavement was merely directory and not mandatory on the commissioners, and that it did not affect the power of the commissioners to award a contract in a case in which the proposal was not made in exact conformity with the regulations prescribed, or the legality of a contract when made. The main point for the commissioners to consider, he said, was the best interest of the citizens and tax-payers of the district. They should accept the lowest bid of a responsible bidder.

Mr. Thomas' connection with the Bermudez Company was well established. The quality of asphalt to be used by that company had stood the closest scrutiny in the tests made to determine its quality; practical work done had demonstrated its character as well as the character of the work the company did, and the company did have its plant in Washington at the time the bid was made.

Another representative for the new company said it was perfectly willing to have 10 per cent. of the contract price withheld for five years, and it would even be willing to make an arrangement by which its work would be guaranteed for ten years.

During the coming fiscal year 40,000 square yards of asphalt pave-

ments are to be laid in Washington. The Bermudez Company asked for a contract of at least 25,000 square yards, because of the expense of establishing its plant here, as it would not pay to take a smaller contract in beginning operations in a new locality.

The commissioners decided to award the new company the contract aggregating 20,000 square yards of asphalt pavement. A similar award was also made to the Barber company.

Prof. De Smedt, who represents the new company, said that its plant was already in the city and would be erected in a short time. He had obtained options on several sites and operations would begin very shortly.

The Barber company, with no intentions of giving up the fight, carried the matter into the court, and asked for an injunction on the grounds that the bid of Thomas H. Thomas was illegal. They claim that the bid of Thomas was interlined with the provision that it should not be less than 25,000 square yards, out of the total of 40,850 required. It was asserted by the Barber company, in their prayer for an injunction, that Mr. Thomas has never been engaged in the paving business, and that he "intends to make use of an inferior quality of material from Venezuela, instead of the best, which comes from Trinidad."

The commissioners answered that the contract was given out after due advertisement, denying that any harm will result from the award, and assert that the bill is "filed in the interests of the Barber Asphalt Company, which seeks a monopoly of the work."

In the answer filed, Thomas H. Thomas, representative of the rival company, says in regard to the allegation that the Barber Company produces the only real asphalt in the country, that "only the paid hirelings of A. L. Barber, who by chicanery and false representations has endeavored to build up and maintain a monopoly of asphalt in this district and elsewhere, could have the effrontery to come into a court of justice and make such bold and unscrupulous statements."

Mr. Thomas avers that the Trinidad Lake asphalt is very far inferior to the Bermudez asphalt, the former having a large per cent. of soluble salts in it which render it wholly unfit for paving gutters where water stands. Mr. Thomas further declared that all the tests made by the district commissioners through their agents have demonstrated that the Bermudez asphalt is the best. Mr. Thomas further declares that he is fully prepared with proper machinery and a full supply of asphalt to pave the whole city better than it has ever been paved before, and that the allegations of the Barber people that he is unable to carry out his contracts are utterly groundless. *A. I. P.*

"WINONA SOCKET" SEWER PIPE.

Mr. Fred H. Pickles, city engineer of Winona, Minn., refers to the style of sewer pipe used in the construction of the sewers in that city as "The Winona Socket Pipe," which, he says, differs materially from the standard vitrified pipe. The "Winona" pipe has a socket three inches in depth, while the standard is only one and one-half inches deep; it has a larger annular space which affords a better opportunity for caulking, and the pipe is made in three foot lengths instead of two. Mr. Pickles thinks the "Winona" pipe is very much superior to any other pattern for sewerage purposes.

STREET PAVING IN BOSTON.

The forthcoming annual report of the street department of Boston, an advanced copy of which we have been favored with by Mr. Henry B. Wood, executive engineer, will show that the mileage of paved streets in that city has increased during the last year from 434.59 to 443.34. The following comparison of the character of pavements in Boston is made with those of other large cities:

	Washington. Per cent.	St. Louis. Per cent.	Chicago. Per cent.	Buffalo. Per cent.	New York. Per cent.	Philadelphia Per cent.	Boston. Per cent.
Sheet asphalt	43.90	1.17	1.40	33.12	8.52	5.00	1.20
Coal tar	15.74	....	....	....	....	....	....
Asphalt block	7.56	....	0.40	....	0.05	2.00	0.16
Block stone	16.82	29.85	2.79	34.60	75.27	20.00	16.87
Wood	....	1.96	63.18	....	....	43.00	1.03
Cobble	....	....	....	....	0.20	5.00	0.08
Vitrified brick	8.98	....	0.07	0.40	0.01	14.00	....
Rubble	....	....	....	....	....	....	....
*Telford	....	7.48	....	0.26	....	....	9.92
*Macadam	8.00	59.64	32.19	31.62	15.95	12.00	37.16
*Gravel	....	....	....	....	....	....	33.58
Burnt clay	....	....	0.02	....	....	....	....
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mileage	165.00	450.00	878.70	879.50	441.54	819 80	443.34

*Not usually separated in the reports of the various cities.

An inspection of the foregoing shows that in Boston only 17 per cent. of the total mileage is paved with granite blocks, 1.36 per cent. paved with asphalt, 0.08 per cent. paved with brick, 1.03 per cent. paved with cobble, the remainder, or nearly 81 per cent., being either macadamized or graveled.

"It is noticeable," says Superintendent of Streets Carter, "that our percentage of macadam and gravel streets is much larger than that of most other cities, and specially prominent is the fact that Buffalo has nearly thirty times as much sheet asphalt as Boston. It is not to be wondered at, in view of the show made by the table, that the expense of maintaining our streets calls for a much larger outlay of money every year than in cities provided with more permanent forms of paving.

"Considering the cost and the temporary results obtained by repairing our macadam roads with a veneer of crushed stone, it would seem to be in the direct line of economy to adopt a more permanent form of roadway surface, suited to our peculiar conditions of business traffic.

"A considerable area has been paved with granite blocks laid with pitch joints on a cement concrete base. The experience with the paving laid in this manner in 1891 is very favorable, and in comparing streets laid in this manner with those laid in the usual manner on a gravel base, the conclusion is irresistible that the new method is worth all it costs, and that all block paving in old and solidly built up business streets should be laid in this manner. The value of the concrete base is unquestionable, while the great practical value of the pitch joint over the gravel joint is that it gives immediate use of the pavement in a clean condition, and saves the weeks and months of mud and dust required to fill the joints by the tedious and unscientific process of grinding up gravel under the wheels of teams, and sifting the powder into the joints by jarring the blocks with the same vehicles. Experiments in a small way have been made by using cement in place of pitch, without decisive results as yet.

Such a compound would have several advantages over pitch, as it would be possible to solidly fill the joints between the stones, and the nuisance arising from heating pitch on the public streets would also be done away with. The difficulty of taking up and replacing pavements laid on a concrete base has not proved so serious in practice as was anticipated, and with suitable and proper precautions should not be a serious objection.

"From its cost this method is not likely to be adopted in streets not yet built upon, and before any pavement is laid it is only fair play to the pavement that all digging up of the street that can be foreseen should be done, and the trenches thoroughly consolidated. Sufficient attention has not been given to this subject, and notwithstanding the fact that all persons and corporations having interests in the street are notified weeks and months in advance, no sooner does the work begin on a street than numerous applications are at once made for new excavations. Manholes and all covers showing on the surface should be easily adjustable to grade, and should be made of non-perishable material, certainly not of wood, and their form and dimensions and location should be controlled by the superintendent of streets. There is great room for improvement in the design and use of these structures.

A large area of sheet asphalt has been laid, and experience continues to show that in the localities for which it is adapted, it is a most admirable pavement. Asphalt blocks have been laid to a small extent this year; they make an excellent surface, but results shown are not favorable for their continued use, due principally to our cold climate.

"No brick pavement has been laid. It is probable that brick pavements are better adapted to districts destitute of suitable stone than to Massachusetts, where granite is an important article of commerce.

"Two of the three streets paved with brick on a gravel base in 1891 seem to withstand the comparatively light travel to which they are subjected fairly well, but the third street shows a marked tendency to chip at the joints.

"In supervising the work of paving, care has been taken to show a smoother and more carefully graded surface than has heretofore obtained. In building a new street with a fall of one or two feet in a hundred, without a street railroad track, and with a pre-established grade, the work of so laying out the the surface as to secure smooth curves, with good surface drainage, is an easy matter. With an old street, with only an approximation to an established grade, with adjoining buildings at different grades, and with all sorts of sidewalk openings into cellars and areas; with a street warped in every conceivable manner, and to crown all a street railroad running through the center that must have a good cross section and suitable lines and grades, the task becomes an engineering puzzle. It is precisely this state of affairs that obtains in the old part of Boston; the grades of the streets within the small limits that apply to surfacing the paving are varied, and as incapable of being reduced to a system as is the ground plan of the same part of the city. The methods pursued previous to the year 1891 have been: First, the street railroad was laid in accordance with the best skill of the railroad engineer, who naturally had the best interests of the road in view.

The edgestones and catch-basins were then placed where necessity compelled; the various manholes and other covers were set *about* right, and finally the paver proceeded to set his paving within the limits remaining for his work.

"In reversing the process above outlined, and in laying out the work to be done on paper in the first place, as had been done during the years 1891 and 1892, and in insisting that every successive workman should bring his work up to the line and grade given, the task of the engineer has been the usual one of the reformer. Many parts of the work have to be done over and over, from the reason that the workmen have not sufficient skill or inclination to work to line and grade, and that it has not been required of them in the past.

"Particularly in laying sheet asphalt on a concrete base has a higher standard of workmanship been called for than ever before, and this year the sub-grade has been made to templet in all cases in which templets could be used, and in this way almost perfect results have been obtained."

The total amount expended for street paving during the year was $1,875,413.24.

Chief Engineer Jackson says that the specifications for granite blocks vary from those of last year in the length of the block called for, the length this year being from 9 to 14 inches, to average 11½ inches, instead of—as last year—8 to 12 inches, to average 10 inches. As a result of the change, about 23 blocks per square yard have been used, instead of about 25 as laid last year; but very few small blocks were used.

GARBAGE DISPOSAL.

On the subject of the disposal of offal the statement is made by the superintendent of streets of Boston, who has been investigating the matter, that it is largely a question of expense, whether or not a nuisance is created in the disposal, and whether offal should be treated for the valuable constituents which are alleged to be present by parties interested in the chemical treatment of offal, or whether the offal should be regarded as a waste product of civilization which should be burned up and destroyed.

"If the offal can be treated chemically and valuable product be produced from such treatment, he says it would seem the proper system to pursue, if the method is conducted without producing a nuisance.

"Compared with any system of cremation, it is believed that the operation of treating offal chemically can be conducted with the least nuisance.

In regard to the proposition made to the city of Boston for chemical treatment and cremation, an investigation would seem to show the following results:

"*First.* If the proposition to treat the offal chemically by the Simonin process was accepted, the city of Boston would be obliged to invest the sum of $175,000 for the purchase of a plant which would be run by the owners of the process, who would pay an annual rental for the privilege of treating the offal and disposing of the manufactured product. The interest on the invested capital of the city (at a percentage which would allow of the establishment of a sinking-fund to renew the plant) plus the miscellaneous expenses, and less the amount

received as rental ($3,500), would represent the annual outlay on the part of the city, and would amount to about $10,000.

"The above argument assumes that the owners of the process are put under bonds so that the capital the city invests in the plant is secure, and the running of the plant for the specified term of years is guaranteed.

"*Second.* If the proposition to treat the offal by cremation was accepted, the city of Boston would be obliged to invest the sum of about $80,000 in plant, and would then be at the expense of running the plant and destroying the offal. The cost of this method of disposal is a very uncertain question. It has been stated in various places as ranging from thirty cents to one dollar a ton.

"It is safe to assume that offal in the city of Boston would cost, at least, seventy-five cents per ton to destroy, and even if mixed with all the available house and store dirt which could be collected in the vicinity, and which would serve as fuel, the cost would not be less than seventy cents per ton.

"The destruction of one hundred and sixty tons of offal would require a yearly expenditure, including interest on plant and sinking-fund, of about $60,000."

PAVING CEMENTS IN AMERICA AND EUROPE.

Mr. Horace Andrews, city engineer of Albany, N. Y., in his annual report, says that in that city, "Greater attention has been paid recently on some of the granite paved streets to the filling of the joints. The layer of sand and gravel, generally spread on the pavement in this country but never used abroad, has been referred to by a distinguished engineer as a survival of a practice originating with cobblestone pavements. The sand covering is soon reduced to a fine dust by the traffic, it is easily washed out of the joints on steep grades, and its use renders it difficult to properly inspect the pounding of the stones and the straightening of the courses. Better jointing material is now used in most of our larger cities, and in almost all cities abroad. From the recent special consular report on streets and highways in foreign countries, it appears that the following materials for jointing stone pavements are employed in various cities:

"Sheffield—Boiled pitch and tar.

"Leeds—Asphalt and coal tar.

"Hull—Coal tar, pitch and thick boiled coal tar.

"London (Greenwich)—Grout of hydraulic lime, one part; sand, three parts.

"Liverpool—Coal pitch and creosote oil.

"Manchester—Tar and asphalt.

"Belfast—Grout of cement (Portland), one part; gravel, five parts.

"Dublin—Hot pitch and creosote oil, with gravel.

"Glasgow—Asphalt, or grout of Portland cement, one part; sand, two parts.

"Edinburgh—Grout of lime, one part; gravel, two parts.

"The word 'asphalt' seems to have been used rather vaguely, meaning usually some coal tar mixture. The general attempt is to get a jointing mixture that shall be durable, water proof, tough and not brittle when cold. The latest New York specifications call for a 'paving cement' of Trinidad asphalt, twenty parts; No. 4 coal tar, 100 parts, and three parts of residuum oil (petroleum), with gravel; which latter material is used abroad in

some cities and in others seems to be entirely omitted."

Mr. Andrews thinks that it would be desirable on streets of heavy traffic to employ coal tar and gravel as a paving cement, while on streets having less travel a good cement grout, or thin mortar might be found to answer nearly as well, and would not be much more expensive than the usual sand coating.

SINGLE COURSE BRICK PAVEMENTS.

The article written a few months ago for PAVING AND MUNICIPAL ENGINEERING by Mr. William M. Whitten, city engineer of South Bend, Ind., advocating single course brick street pavements, has been widely copied and commented on. In a recent letter Mr. Whitten says:

"I am surprised as well as flattered at the amount of attention this article has received as indicated by the clippings you have sent as well as quite a number of papers sent me directly by publishers, and also by a large number of personal letters from engineers and city officials scattered from Connecticut to Montana and from Canada to Tennessee. These show a wide circulation of your magazine, as well as a very general interest in the subject of brick for pavements. Some of the comments give me credit for new ideas in advocating single course pavements. Now this is more than I claim or deserve, for the reason that some of the first successful brick pavements laid in this country were single course pavements on cinders or furnace slag as a foundation. The double course pavement is a later invention, and with a good foundation under the flat course will undoubtedly make a good pavement; if that foundation be bad it can not be expected that the finished pavement will be good, at least such has been the experience in this city. I am pleased to note that in his last annual report the city engineer of Memphis, Tenn., recommends the courses of brick pavement to be laid at an angle of forty-five degrees instead of ninety degrees. This makes me feel less lonesome in that practice."

ASPHALT MINES IN TURKEY AND SYRIA.

The latest consular report issued by the state department contains information regarding asphalt mines in Turkey and Syria. Consul-General Hess, writing from Constantinople, says:

"There is an important mine of asphaltum near the seaport of Avlona, on the Adriatic Sea. This mine belongs to the domain of the sultan, and is rented by a French company for a period of thirty years. The company is represented here by the Imperial Ottoman bank. Asphaltum is extracted from the mine both in liquid and solid condition, and is exported to Europe and America. There are two or three asphaltum mines in Turkey in Asia, in the neighborhood of Erzerum, belonging to the government and private parties, but they are of less importance. These mines are situated in the interior of the country and are not worked, owing to the lack of facilities for transportation. Nothing is known here about the methods of preparing the so-called Egyptian asphaltum obtained from mines in Turkey, as it is exported in its natural state—liquid or solid.

Vice-Consul Khouri, of Beirut, makes the following report regarding asphalt mines in Syria:

"Four asphalt mines are known to exist in Syria. One is situated

in the vicinity of Hasbaya, about forty miles southeast of Beirut; the second in Sohmor, about thirty miles to south of this city; the third is near Ain-Ettineh village, seventy miles to the east of Beirut, and the fourth is found in the valley of the Dead Sea. Of these mines, the one at Hasbaya is the most important, and the asphalt obtained from it is considered the best, with the exception of that of the Dead Sea, which floats in small quantities on the surface of the water and drifts ashore, where it is picked up by the Bedouin Arabs.

"Until 1860 these asphalt mines were almost entirely neglected, and the fellahs used to dig, free of tax, small quantities, which they applied to the stems of their vines to destroy worms that ravage the vineyards.

"In 1864 the asphalt mine at Hasbaya was leased by the Turkish government to two native merchants—Messrs. Freige & Misk—for a term of four years at a rental of 80,000 piasters ($3,520) per annum. The operations of this company did not prove very successful, lack of an adequate system of engineering greatly reducing its profits.

"In 1879 the mine was leased by the firm of Messrs. Tabet & Co. for four years, at an annual rental of 250,000 piasters ($11,000). During these four years about 4,000,000 kilograms (4,400 tons) of asphalt were extracted.

"At the expiration of the lease the mine was leased to another company—Absy & Co.—for a term of ten years, commencing in 1888. The condition was that 65½ per cent. of all the asphalt extracted should go to the agents of the imperial private treasury, the mine being the private property of the sultan.

"During the last five years the amount of asphalt obtained by Messrs. Absy & Co. from the Hasbaya mine is estimated to be 5,400 tons. The company's success has been mainly due to their skillful engineering and methods of excavation.

"No asphalt is at present extracted from the other mines in Syria, as the local Turkish authorities strictly prohibit their being worked.

"When Messrs. Freige & Misk first worked the Hasbaya mine the asphalt was sold in Europe at an average rate of $19.30 per 100 kilograms (220 pounds). Its present price in the foreign markets is between $8.69 and $9.65 per 100 kilograms.

"The Syrian asphalt is subject to no tax except an export duty of 1 per cent. It is rumored, however, that a new rescript issued by the sultan enjoins that no export dues should be hereafter imposed on that article.

"The exact quantity of asphalt now in stock can not be ascertained, as the parties who monopolize it decline to give the figures. It is probable, however, that not less than 3,000 tons are stored for sale by the agents of the imperial treasury and the mining company.

"The asphalt obtained from the Syrian mines is invariably exported to Europe and America in its natural state, without undergoing any process of preparation.

"The following table shows the value of that exported from Beirut to the United States since 1882, when the first important shipments were made:

Year.	Value.	Year.	Value.
1882.....	$12,239.00	1890.....	$6,983.00
1883.....	11,576.99	1891.....	7,303.03
1884.....	6,095.00	1892	21,207.44
1885.....	3,176.30		
1889.....	1,958.17	Total..	$70,538.93

"During the years 1886, 1887 and 1888 none was exported from this consular district to the United States, owing to low prices in America and a scarcity in the supply for home consumption.

"From statements made by a number of reliable persons, it seems very probable that asphalt exists in large quantities in all the mines which have been discovered, and that thousands of tons might be extracted every year if the local authorities would allow the mines to be worked.

"The following is a detailed analysis of the asphalt taken from the Hasbaya mine:

"The weight of the specimen was 575 grams.

"This asphalt is black in color, of a bright, jet-like luster, making a blackish-brown streak on unsized paper.

"Its brittleness is extreme; splinters may be easily chipped off with the fingers.

"Its specific gravity is 1.104.

"It is very combustible. It readily burns with a heavy, yellow flame, yielding much soot and a 'bituminous,' though not very disagreeable, odor. A splinter held in a flame melts and drops off before igniting. On burning it swells up, and bubbles of gas escape. Six grams ignited and incinerated for an hour over an alcohol flame lost 4.5 grams in weight, or 75 per cent.

"Pulverized it is brown in color and slightly gummy. Two and one-half grams of the powder destructively distilled for an hour readily melted, then gave off gases which quickly ignited and burned for about fifteen minutes with a clear, white flame of about 1 candle power and for a somewhat longer period with a feebler flame. The loss of the volatile hydrocarbon gases distilled from 2.5 grams was 1.7 grams, or in other words, the bitumen contains 68 per cent. of volatile hydrocarbons, and would, therefore, furnish valuable material to enrich illuminating gas."

THE PECOS VIADUCT.

At the regular meeting of the Engineering Association of the South, at Nashville, Tenn., June 3, 1893, a paper on the Pecos viaduct was presented by Mr. J. Kruttschnitt. In the original construction of the Galveston, Harrisburg & San Antonio R. R., of the Southern Pacific system, the deep canon of the Pecos river presented such difficulties that, to avoid it, a considerable detour was made, and the line built with heavy grades and curvature, yet at great expense; besides, the operating expenses were large, the unstable condition of the adjacent limestone necessitating constant patrol of the track and reduction of train speed. These disadvantages led to the location of a cut-off, crossing the Pecos river on the viaduct described. The two lines are thus compared:

	Operated line.	Cut-off.
Actual length in miles	24.5	13.3
Comparative length reduced to level tangents	33.77	17.9
Wooden trestles, feet	3,600	600
Iron bridging, feet	2,780	2,180
Weight of iron bridging, lbs.	3,893,000	3,640,000
Total curvature, degees	2,926.6	991.7
Maximum degree of curvature	10	5
Maximum grade in feet per mile	52.8	52.8
Rise and fall, feet	902.27	524.38

The masonry, piers and footings are of tough limestone, laid in Portland cement mortar, and were built between March and November, 1891, 3,270 cubic yards costing $70,000.

For comparison, the lengths, heights and weights of the six highest viaducts are given:

NAME.	Length between abutments.	Base of rail to water level.	Weight in pounds.	Wt. per sq. ft. vertical proj.	Live load per lineal foot.
Garbit...	813.00	401.80	7,040,000	22.74	3,220 lbs.
Loa.....	800.00	336.00	2,497,600	20.00	2,800
Pecos....2,180.50		320.89	3,640,000	13.32	5,000 and 30,000 conc.
Malleco..1,139.80		312.90	3,148,886	15.50	2,750
Kinzua...2,044.00		301.10	3,500,000	3.10	
Evaux...	812.20	299.50	2,682,998	19.17	

This table shows that the Pecos ranks one of the highest viaducts for standard gauge in the world, also that it leads in live-load specifications and lightness. One of the most remarkable features in the work was the traveler used in erecting; it had an overhung, perhaps hitherto unequaled, 124.5 feet, which was secured by a 57 foot wheel base, the traveler being counterbalanced and clamped to the comcompleted parts of the structure. The iron was brought out on push-cars on the permanent track, taken by the crab on the traveler, lowered and held in position till the connections were made. The heaviest pieces weighed 11 tons. After erecting the east half of the structure, the traveler was taken to pieces and shipped by the operated line to the west half, a lighter traveler meanwhile raising the short towers at the west end. In erecting the east half 41,000 pounds of iron was averaged per day, net time, and 62,000 pounds in the west half. The average number of men employed in erecting was 67, and 87 working days were consumed between beginning erection and connecting the suspended span. The floor timbers are covered with galvanized iron for fire protection. Total cost of the viaduct, $250,000. The paper was fully illustrated by drawings and photographs. The next meeting of the Association will be at Nashville, July 13, 1893.

Walter G. Kirkpatrick, Sec'y.

LEGAL DECISION.

Dedication of Highways.—Marking a street on the plat of a town, or addition thereto, and selling lots with reference to such street, dedicates the ground so marked to the use of the public as a street; and the purchasers of lots have a right to have all streets marked on the plat by which they purchased, kept open. Where a town has been laid out, and one of the streets, as originally marked, used by the public for forty-five years, mere non-user of a portion of such street, occasioned by being fenced in with abutting property for forty years, will not estop the town from reclaiming such portion, or give title by adverse possession, nor will it amount to an abandonment by the public. Wolfe *v.* Town of Sullivan, Supr. Ct. of Ind., 32 N. E. Rep. 1017.

NOTES OF PUBLICATIONS.

"Life and Times of a Civil Engineer," is the title of a volume of 140 pages by James M. Searles, of Vicksburg, Miss. The purpose of the book, Mr. Searles states, is to direct the attention of the United States Congress to the question of how the Mississippi river problem can best be solved. The publishers are Robert Clarke & Co., of Cincinnati, O.

Vol. 7 of the Technograph, issued by the engineering societies of the University of Illinois, contains a variety of articles on engineering subjects, including pile foundations, transverse strength of brick masonry, state inspection of bridges, etc. Published at Champaign, Ill. Price, 50 cents.

PHILADELPHIA'S PROPOSED BOULEVARD.

The Park Boulevard, running from the new City Hall to Fair-

mount Park, in Philadelphia, has been officially placed on the city plan by the board of district surveyors, in accordance with an ordinance passed by the city councils on April 12, 1892. It now seems certain that Philadelphia will some time have a magnificent diagonal boulevard, and the long-prevailing rectangular street system will be broken in upon. The estimated cost of the improvement is $6,000,000, but councils have yet to raise the money and authorize the department of public works to go to work.

PERSONALS.

Mr. Luther Dean has been elected city engineer of Taunton, Mass.

Mr. W. P. Rice has been appointed city engineer of Cleveland, Ohio.

C. E. Abbott, J. L. Smith and W. S. Junkins have been elected sewerage commissioners at Andover, Mass.

Mr. Arthur Thorpe has been elected city engineer of Greencastle, Ind.

Alexander Dow has been appointed electrical engineer of the Public Lighting Commission at Detroit, Mich.

Mr. A. W. Cooke has been appointed chief engineer of the Street Department, at Chicago, Ill.

SELECTIONS FROM THE PRESS.

MUNICIPAL PROGRESS.

There has lately been established a monthly magazine called "PAVING AND MUNICIPAL ENGINEERING," which is devoted to the conduct of municipal works. Municipal engineering and other technical matters connected with the administration of a city are discussed by those able to give light upon these various matters, and by use of this magazine the head of a city department is enabled to keep informed of the advance in his business all over the country.

The appearance of this magazine is significant; it marks the fact that we have come into a new era of municipal administration—an administration in which the business and technical side of city affairs is to be of much more importance than the political side.

Many people do not realize the great change which has come in the conduct of city affairs during one generation. Take our own city for an illustration. When, in 1846, the city was incorporated, any well informed citizen in the community was perfectly competent to direct the affairs of any of the departments. No technical knowledge was needed. There were no questions involved in the administration of city affairs that the citizen did not have to meet in the conduct of his own business.

Now the situation is different. The growth of the city—but more than this, the modern inventions which have made the city's growth possible—demand that each department be conducted by men of technical knowledge and skill. For the proper administration of these departments a considerable degree of scientific training is absolutely necessary. The merely well in-

formed citizen is no longer competent to fill any one of these offices.

It is along this line of development that we look for the final triumph of the idea that the municipality is a business corporation rather than a political body. If the heads of departments must be removed from politics, because scientific men and not politicians are absolutely necessary, then it will finally become apparent to all that the mayor, who presides over all these departments, must be distinguished more for his ability in the domain of applied science and for his business sagacity, than for those qualities which make the politician. And as with him, so with the members of the city council. With the advance of applied science in city affairs, the mere politician finds the office less and less congenial. It is not too much to hope that he will finally be forced out altogether.—*Cambridge (Mass.) Press.*

THE PAY AND STANDING OF CIVIL ENGINEERS.

In a communication to the engineering students of Dartmouth College, Mr. B. S. Church, late chief engineer of the New Croton aqueduct, takes up the subject of better pay and broader professional recognition for civil engineers. As he says, no profession is so poorly paid; $10,000 per year is considered an excellent equivalent for the best professional talent; $2,000 to $3,000 is good enough, and $1,200 to $1,500 may be taken as the average annual pay that capable, educated and experienced men are sometimes compelled to accept. Yet the men even in receipt of the lower salaries here named frequently are in charge of hundreds of thousands of dollars worth of public works, the proper and economical execution of which depends upon their personal experience and judgment; and the works in charge of men of the higher grade represent millions in expenditure. In England, on the other hand, engineers of the highest rank receive a percentage on the cost of the work in their charge, as architects do in this country, and on great works their compensation may thus amount to $50,000 or more per annum. Mr. Church believes that the poor pay of American engineers is due to the habit of fixed salaries suggesting limitation, and to a lack of any organized effort on the part of the profession to reform existing methods. He says it is for the fresher, younger engineers to seek to place the profession of engineering where it should be; to determine on a professional code; and to arrest the apparent downward trend of the last thirty years, in permitting acts among members of the profession to pass unnoticed now that in earlier years would not have been admissible among men of a delicate sense of honor.—*Engineering News.*

EXCLUSIVE STREET RAILWAY FRANCHISES.

There is nothing connected with the legal rights of street railway companies which is more elusive than the so-called "exclusive franchise." Promoters of street railway enterprises are continually struggling for grants of this character and are continually realizing, after they have been secured from the municipal authorities, how little substance is in them. It is not an exaggeration to say that not one-half of the exclusive privileges granted have been sustained, and for the

reason that the town or city pretending to make the grant is giving away something that it does not possess. The majority of the decided cases lay down the rule that nothing short of express legislative authority will authorize a municipal corporation to grant for a term of years the exclusive right to occupy its streets with street railways. Of course it is always urged that the construction of street railways necessarily requires the expenditure of a large sum of money, and that private persons will not engage in such enterprises without an assurance that they will be protected from competition for a sufficient length of time to remunerate them for the outlay; but this is an argument to be addressed to the legislature and not to the courts.

The case which calls forth these comments is Parkhurst *v.* City of Salem (Ore. Sup. Ct., Feb. 13, 1893). Here the city of Salem was given the legislative authority "to permit, allow and regulate" the laying of tracks for street cars. It granted an exclusive franchise for thirty years. Long before the expiration of this time it granted a franchise to another company to use the same streets. The company which had the exclusive right sought to enjoin the construction of the second road, but was unsuccessful. The court held that the "exclusive" part of the first grant was void, citing a large number of cases. It may be mentioned that there are cases in Kentucky and Iowa which apparently hold a contrary doctrine, viz: Newport *v.* Newport Light Company, 84 Ky. 167, and Des Moines R. Company *v.* Des Moines, 73 Ia. 513, but these cases have often been criticised and declared to be contrary to the decided weight of authority. —*Street Railway Journal.*

THE TROLLEY ON THE ERIE CANAL.

Within the next few weeks some experiments will be made by Mr. Hannan, state superintendent of public works, with the view of testing the feasibility of operating the Erie canal by electricity, in accordance with the recommendation of Governor Flower. The trolley system is to be tried and $10,000 are available for the experiment. According to investigations made $1,000,000 would equip the canal and provide for twelve power-houses thirty miles apart. There is abundant water power along the route for generating electricity. The total expense to each boatman for a dynamo would be from $150 to $200.

It is claimed by Governor Flower that it now costs the boatman on an average two dollars per day for horse power; while it is estimated that the trolley system of towage would only cost sixty cents per day, and that this would make so much difference that at two cents per bushel for grain carried the boatmen could make money; the present charge is four and three-eighths to five cents per bushel. The maintenance of the towing-path now costs about $400,000 per annum, and this sum would be saved if the trolley were adopted.

The members of the union for the improvement of canals are not enthusiastic over Governor Flower's plan. They say it will cost more than $1,000,000 to equip the canal, and that the figured cost of sixty cents per day to the boatmen is much too low. Others say that the true solution of the problem is to deepen the canal to nine feet and then use a steam towage system, with an increased speed per hour of from five to six miles. The trolley presupposes a screw propeller on

the boat operated by transmitted power, and many believe that the present section of the canal does not furnish water enough for this use of the screw. The overhead cable system is more favored by some, as providing a dead pull, without the slip and waste of power incident to screw propulsion.

Mr. Horatio Seymour, ex-state engineer, says that the true solution of better canal service is to deepen the canal to nine feet, at least, for no vessel can be propelled with economy in a shallow channel. He believes that this depth could be secured for about $1,000,000 over the whole canal, and that the carrying capacity of each boat would be increased by fifty tons by one foot more of draft thus secured. *Engineering News.*

MACHINERY AND TRADE.

RECENT INVENTIONS.

Manufacture of Portland Cement, 497,785, by Martin L. Griffin, Holyoke, Mass. This invention consists in producing precipitated carbonate of lime by the addition of lime to a soluble carbonate, such, for example, as sodium carbonate, and then mixing the precipitate with clay or other aluminous material in proportions, and drying, calcining and grinding the compound thus obtained.

A Pipe Coupling, 497,990, by Wm. W. Simrell, New York, N. Y. This invention comprises an internally threaded coupling sleeve provided with a removable abutting ring, and externally threaded pipe section provided with a plain extension adapted to enter the ring, and a packing ring or gasket interposed between the pipe and ring.

A Garbage Receptacle, 498,011, by Philip Jasnowski, Detroit, Mich. This invention comprises a casing, pivots upon which the casing is journaled, a shaft journaled above the casing, an arm on the shaft engaging the casing to hold it in its closed position, and a key for turning the shaft to disengage the lock.

A Cesspool, 498,287, by Matthew Moriarty, Bangor, Me. This invention consists of a case having its open end and a portion of its length inserted in the outlet drain, the case having its opposite end closed and an inlet opening from its under side next adjacent its closed end, a swing valve extending from the upper corner of the case diagonally across the inlet opening, and a cleanout opening provided with a cover directly above the swing valve.

A Street Sweeping Machine, 498,402, assigned to Laura Shave, New York, N. Y. This invention comprises a frame having a main shaft or wheel axel, two rotary brooms having their axles at a right angle to each other or nearly so and at an oblique angle to the wheel axle, one of the rotary brooms being supported in advance of the wheel and the other in the rear thereof, gearing for actuating the brooms from the wheel axle, obliquely arranged dirt boxes or receptacles for the dirt lifted by the brooms, and means for raising and lowering the boxes and brooms together.

A Bridge Gate, 498,463, by Ernst

C. Dittmann, Chicago, Ill. This invention comprises tripping arms secured to the platform of the bridge, with a number of pickets or uprights adapted to engage the tripping-arms and to be raised and lowered thereby, and a bracket or bearing for the pickets, having a flange or projection to hold them in a horizontal position.

A Bridge Post, 498,559, by James B. Marsh, Des Moines, Iowa. This invention comprises a base or pier having a vertical bore to admit a post, a plate adapted to rest upon the top of the pier and provided with an opening coinciding with the bore in the pier and means for fastening the plate to a post, and a post extending downwardly through the coinciding openings in the plate and the base or pier.

A Sewer Cleaning Brush, 498,659, by Septer E. Johnston, Selma, Cal. This invention comprises a cylindrical tube, sections fitted spirally around the tube from end to end and bolted thereto, brush wires bent twice at right angles and fixed in sets, holes made in the sections so as to project radially from the surface of a tube, and swivels at each end of the tube for the attachment of ropes by which it may be hauled backward and forward through the pipe to be cleaned.

A Wheeled Scraper, 499,038, assigned to the Rathbun Manufacturing Company, Sioux City, Iowa. This invention comprises a pan or scoop and its connections, a cranked axle having spindles at the ends of its arms, carrying wheels mounted on the spindles and having toothed raising wheels rigidly secured to the inner sides concentric with their hubs, castings secured to the axle arms, and a longitudinally movable lifting bar extending across the vehicle and having one hooked end and one straight end, projecting through slots in the castings, for engagement with the raising wheels.

A Grading and Ditching Machine, 499,178, Christopher B. Taylor, Idaho Falls, Idaho. This invention comprises a main carrier, a rear carrier, a longitudinal rack secured to the rear carrier, a pinion engaging the rack, a secondary rack secured to one end of the main carrier, and substantially at right angles to the former rack, a pinion adapted to engage with the secondary rack, and means for revolving the pinions.

An Electric Hose Coupling, 499,254, by Howard Sargent, Cambridge, Mass. This invention comprises a half with a shoulder having a hole through it, a plug of insulating material contained in the hole, also having a hole through it, an electric wire, a metallic cap, and a spring connecting the cap with wire, and all contained in the hole in the plug, the other half reamed out at the end, a flanged ring of insulating material and a metallic flanged ring secured to a ring, and wire secured to a metallic ring.

An Apparatus for Treating Asphaltic Mixtures, 499,256, by Samuel R. Scharf, Washington, D. C. This invention comprises a tank having its walls composed of wood or similar heat retaining material, provided with doors at top and bottom, and having arranged therein a series of pipe coils for the reception of steam.

A Scraper, 499,477, by Benjamin F. Shuart, Bozeman, Mont. This invention comprises a swinging draft-bail and blade arranged between sides or fenders which pre-

vent the scraped up soil from spreading, a toothed soil breaker positioned in advance of the blade and movable up and down in unison with the rise and depression of the same.

An Apparatus for Treating Sewage, 499,583, by James J. Powers, Brooklyn, N. Y. This invention comprises semi-circular sluices forming two series, each series being in communication alternately at opposite ends, the inner one of the series being arranged to discharge into a central reservoir, dip boards and strainers placed in the sluices which arrest floating and submerged matter carried in the sewage, perforated pipes placed in the sluices and communicating with the chlorine gas supply, siphons communicating between the central reservoirs and the waste pipe, so as to cause an intermittent discharge of the reservoirs, and a disinfecting tank furnished with float-operated automatic valves for admitting disinfectants to the central reservoirs and to the inlet end of the sluices.

A Truss for Bridges, 499,631, by George T. Hawes, Owensborough, Ky. This invention comprises a metal cap piece, inclined counter end struts, made of plate metal of approximately triangular form in cross section, and having horizontal bolting ends or flanges, inclined intermediate struts formed of plate metal of the same form as the end struts, and applied in pairs and as counter braces, and against the cap plate or piece, and those of each pair diverging from the cap plate out of line with one another longitudinally of the base plate, downwardly and laterally, so that their approximate lower ends stand out of line with one another longitudinally of the base plate.

V. H. Lockwood, Patent Att'y.
Indianapolis, June 20, 1893.

SHALE BRICK FOR PAVING.

The Canton Brick Company, of Canton, Ohio, has issued a little pamphlet on the superiority of shale brick for paving, building and sewer purposes. The company is a pioneer in the shale brick industries of Ohio. Their red granite pavers are in use in many cities and towns. Having an abundance of fire clay as well as shale, they made experiments at the outset to demonstrate which clay would make the best paving brick. They say:

"All fire clay was first tried, then different proportions of fire and shale clay were mixed, but it was found that the best results were obtained in using all shale, as the brick could be more thoroughly vitrified, made denser in body, stronger, and far more durable; hence shale clay was adopted, and each year has demonstrated the wisdom of such a course and our persistent advocacy of this material. The demand for Canton shale pavers has always been in excess of the supply, notwithstanding the fact that our works have been increased from a capacity at first of about 2,000,000 to 12,000,000 annually and that new brick plants have sprung up all over the country as competitors, which is ample evidence of appreciation on the part of public officials who have given the street paving question careful study."

In discussing shale brick paving they further say:

"The cost of construction is moderate and in way of repairs nothing. A shale brick pavement on a good foundation is almost indestructible. It is clean and smooth, and shale clay can be thoroughly vitrified and annealed; brick can be made close in body and are non-absorbent. They are harder than tempered steel, and horses' calks make no

impression on them. The interstices between brick, though small, afford a sure footing for horses, and unlike block stone when the edges are chipped and rounded off, the pavement never becomes rough. From a sanitary point of view this pavement has no equal and it may be justly claimed for this material that it possesses the best qualities of all others without any of their defects, and we assert that for general use in cities, large or small, these pavements well constructed will cost less to build, less to keep in repair, will wear longer, prove cheaper in the end and more satisfactory in every respect than any other pavement now in use.

"In order to show the great strength of Canton vitrified shale paving brick it may be well to state that tests have been made under hydraulic pressure by the Keystone Bridge Company, of Pittsburgh, Pa., showing the crushing strength of our ordinary make of shale brick to be over 301,000 pounds, or more than 14,000 pounds to the square inch. Further, that in all tests when fairly made in either tumbling or absorption, Canton shale pavers have invariably come out of such tests far in the lead over all others.

"Many miles of Canton shale brick pavements have been laid as the following names of cities and towns where they have been used will show:

"Lexington, Ky.; South Chicago, Ill.; Detroit, Mich.; Tonawanda, N. Y.; Philadelphia, Pa.; Akron, Alliance, Bellevue, Berea, Cleveland, Cincinnati, Canton, Dayton, North Baltimore, Youngstown, O.; Anderson, Elwood, Fort Wayne, Indianapolis, Marion, Richmond, Tipton, Terre Haute, Ind."

CLAY TESTING.

J. W. Penfield & Son, of Willoughby, Ohio, have just issued a little pamphlet entitled "Clay-Testing," in which they explain the various tests they undertake to make of clay sent to them, and thus determine not only its qualities, but what kind of machinery is best suited to it. By way of introduction of the subject they say:

"Prospective brick makers, before embarking in the business, should have their clay properly tested to determine the following points:

"1. Whether the clay is suitable for the manufacture of merchantable brick.

"2. By what process the best results can be secured.

"3. What machinery will be necessary for the most successful work.

"4. If paving brick are to be produced, a special test should be made to determine whether the clay will successfully vitrify.

"The fact that brick have been successfully made from any clay by *one* process or machine, does not prove that it would be equally well adapted to working on machinery of another class or by another process. Some clays can be successfully worked by a number of different methods; others by only one method, while still others are entirely unsuited for brick-making purposes.

"So, too, the machinery that with one kind of clay is a complete success, may, with clay of a different nature, be an utter failure.

"Hence, the testing of the clay, or at least careful examination by experienced parties, is an essential preliminary to the judicious selection of machinery."

NOTES.

John G. Tait & Co., of New York, have a contract for supplying the New York department of public works with "Straight River American Paving Cement Nos. 5 and 6," which is used as a filling between paving blocks, granite or brick, and also as a flint or binder in concrete work.

Upwards of thirty large kilns, are in course of erection by the Sercombe, Osborn & Warren Company, the latest addition to the list being the Franklin Paving Brick Company, Franklin, Pa. Mr. G. Warren, one of the firm, will very shortly arrive in this country. Letters addressed G. Warren, care of Hancock Fords, N. J., will find him.

The Enterprise Manufacturing Co., of Columbiana, Ohio, has just shipped a six-ton roller to Walla Walla, Wash.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Considerable street improvement is being made at Ogdensburg, N. Y.

Vitrified bricks are being used between the tracks of the trolley lines, Wilkesbarre, Pa.

The city of Waukon, Iowa, has purchased a rock-crusher and will proceed to macadamize some of the principal streets.

Many of the new streets at Schenectady, N. Y., are being graded, curbed and flagged, and many old ones are being recurbed and flagged.

H. C. Graves, Alexandria, Va., writes that cobble-stone is used altogether as a paving material in that city, but that there is a growing desire for something better.

Savannah, Ga., has 115 miles of streets, of which 22 miles are paved with stone, shell, macadam and asphalt. More paving will be done this season, and it is proposed to try brick.

C. M. Kickard, city engineer, Springfield, Ill., writes that the work already contracted for this season will comprise about five miles of brick street paving, one mile of curbing and a considerable amount of brick sewers.

J. F. Bradley, city engineer, Ithaca, N.Y., writes that the city is expending about $40,000 each year for paving. Two years ago the city commenced by putting down Telford macadam, last year Telford macadam and brick, and this year brick.

Tohn T. Desmond, city engineer, Haverhill, Mass., writes that all city work is done by day labor, the city advertising and securing all material. Orders have recently passed the council for 10,000 square yards of granite paving, one and one-half miles of sidewalks, one and one-half miles of sewers, and other miscellaneous work.

The board of public works of Detroit have decided that the Medina stone used for curbing shall be quarried according to certain specifications which the quarry men refuse The inspection is beyond the requirements for similar stone in Buffalo, Chicago or any other city so far as can be learned. The contractors are therefore badly hampered in their work, and they affirm that the requirements exacted do not add any value to the curb, while the innovation costs the contractor more than his profits amount to.

CONTEMPLATED WORK.

The question of paving the business streets in Allegan, Mich., is being discussed.

The Ribb county (Ga.) commissioners are considering a proposition to issue bonds for $40,000 for road improvements.

A portion of the citizens of Crawfordsville, Ind., are contemplating the paving of Main street with brick a distance of 8,000 feet.

M. T. Dozer, city engineer, Ashland, Wis., writes that probably fifteen or twenty blocks of cedar block pavement will be laid this season.

The city engineer of Spokane, Wash., writes the matter of street paving is being discussed at present and some pavements may be laid this fall.

The town council of Oakland, Md., has decided to employ an engineer to establish grade, set curbs and replace wooden sidewalks with brick pavement.

A petition is being circulated to pave the remainder of Union street, Schenectady, N. Y., with block asphalt, part already being paved with sheet asphalt. This will probably be presented to the common council at the meeting July 11th.

Two petitions have been presented to the common council of Schenectady, N. Y., in relation to the repaving of Jay street. One asks for the paving with block asphalt and the other with sheet asphalt. Both pavements have many friends there as there are samples of both in the city.

CONTRACTS TO BE LET.

It is reported that Salamanca, N. Y., will pave Main street.

It is reported that the principal streets of Coldwater, Mich., are to be paved.

The town of White Plains, N. Y., has voted to expend $50,000 on highways.

Plans are being made for a road from Baker City to Eagle Valley, Oregon, about thirty-three miles.

The city council of Pawtucket, R. I., has voted to widen East avenue to sixty feet at an estimated cost of $100,000.

S. Craig, Wapakoneta, Ohio, invites bids up to July 6th for grading and graveling about eleven miles of River Road Pike.

Bids will be received at the office of the city civil engineer, Bucyrus, Ohio, until July 11th, for improving sundry streets.

Bids will be received until July 20 for paving East Battery and South Bay streets, Charleston, S. C., with Trinidad Lake asphalt.

E. E. Forbes, Clinton, Iowa, writes that contracts for about five blocks of brick paving will be let in the early part of this month.

Bids will be received by the county auditor of Pickaway county at Circleville, Ohio, until July 6th, for graveling and repairing several turnpikes in that county.

C. F. Lane, clerk of Berea, Ohio, writes that sealed bids for about 100,000 square feet of brick pavement will be received July 10, 1893; also about 6,400 linear feet curbing.

Wm. J. Luther, Attleborough, Mass., writes that about 2,000 square yards of concrete for sidewalks will be contracted for; also about 4,000 square yards of macadamized road.

J. F. Seward, Mansfield, Ohio, will receive sealed proposals until July 12, for excavating and grading what is known as the Olivesburg road, near the Ohio Reformatory.

Geo. F. Fullinwider, El Dorado, Kansas, writes that ordinances have passed the city council ordering about 1,500 feet of stone sidewalks four feet wide and four inches thick.

Wm. M. Whitten writes that sealed bids will be received until July 24 for about 30,000 yards of brick paving to be laid on Washington, Jefferson and Wayne streets, at South Bend, Ind.

Proposals are to be received by the common council of Hornellsville, N. Y., until July 5, 1893, for 25,000 square yards of brick pavement with concrete foundation. F. A. Dunham is engineer in charge.

Bids will be received by J. F. Seward, county auditor of Richland county, Mansfield, Ohio, until July 12 for the excavating and grading of what is known as the Olivesburg road, near the Ohio Reformatory.

W. F. Davis, Bozeman, Mont., writes that the city council has ordered about three blocks, 1,200 feet in length, to be paved with Telford macadam and cut stone curb and gutters. Further orders are likely to follow.

T. L. McConnell, Lexington, Ky., writes that the general council has accepted the profile, plans and specifications for the reconstruction of sundry streets with brick pavement, including about seven miles of streets.

Sealed proposals are advertised to be received by A. J. Frame, county auditor of Athens county, Athens, Ohio, until July 7th, for grading, excavating foundation, limestone graveling, etc., of several roadways in that county.

Wm. M. Whitten, of South Bend, Ind., writes that the common council of South Bend, Ind., at its meeting June 26 passed resolutions for brick pavements on Vistula and Laporte avenues, amounting to about 20,000 square yards. Bids will be received for same until July 24.

Bids will be received at the board of administration's office, Cincinnati, Ohio, until July 14, for the improvement of Pullan avenue from Chambers street to Hamilton avenue, by grading, curbing and paving the roadway with brick and constructing the necessary culverts, drains and retaining walls.

CONTRACTS AWARDED.

The city of Saginaw, Mich., has contracted for about $97,000 worth of paving this season.

John Twiname was awarded the contract for constructing roads at reservoir M in North Salem, N. Y., to cost $64,530.

Knoxville, Tenn., has contracted for about 46,000 square yards of brick paving to be laid in that city this season.

The Rochester Vulcanite Company procured the contract for paving Grand avenue with asphalt at a cost of $58,382 at Rochester, N. Y.

The Northern Ohio Paving and Construction Company was the lowest bidder for five contracts at Cleveland, Ohio, which amount to $60,000.

Chas. H. Coones, Lockport, N. Y., writes that Charles Whitmore & Co. were awarded the contract to pave Niagara street with U. S. brick at $2.07 per square yard.

H. Ward, assistant city engineer, Binghamton, N. Y., writes that the Warren-Scharf Asphalt Company will pave a part of Front street at $2.70 per square yard.

Fred H. Pickles, Winona, Minn., writes that the Winona Construction Company have been awarded a contract for 73,000 square yards brick paving at $1.44 per square yard, and 26,000 linear feet of limestone curbing at 53 cents per foot.

Albert E. Andrews, Warren, Ohio, writes that Dean & Caldwell, of Youngstown, Ohio, were awarded the contract for paving Main street and Mahoning avenue with the Salineville repressed paving brick on a concrete foundation with a Forest City filler. The paving includes about 12,500 square yards.

O. Mulvey, Wichita, Kan., writes that the Barber Asphalt Company have the contract for repaving about 30,000 square yards of Douglas avenue which has heretofore been paved with Drake's patent jasperite. They will get $2.80 per square yard.

Daniel Salmon has been awarded a contract for improving 2,100 feet of Kyger street by grading, graveling roadway, curbing and bowldering gutters and brick sidewalk at $2.78 per foot, and John A. Ross awarded a like contract on Fourth street at $3.10 per foot, at Frankfort, Ind.

J. C. Boyd, Sacramento, Cal., writes that a contract has been awarded to the City Street Improvement Company, of San Francisco, for the paving of about 121,000 square feet of bituminous rock on K street from Second to Tenth streets, the railroad company at the same time being obligated to construct about 63,000 square feet additional of the same character. The plans contemplate grading and rolling a layer of concrete six inches thick, laid, tamped and set for seven days, and subsequently covered with a layer of bituminous rock 2¼ inches thick and rock gutters 4 feet wide, set on 4 inches of concrete and tamped and grouted.

Asphalt paving will be put down on Peachtree street, one of the principal residence streets of Atlanta, Ga., from Pine street to the city limits. The work will be done by the Warren-Scharf Asphalt Paving Company, and will be completed as soon as possible, at an estimated cost of $52,461. The city and street railway company will pay on this work $26,637 (of which $12,912 is estimated to be paid out of the city treasury, and $13,725 is assessed against the Consolidated Street Railway). The balance of the assessment is to be paid by the property owners, either one-fourth cash and balance in equal installments in one, two and three years, at seven per cent. interest, or all cash.

James Wilcox, city engineer, Paducah, Ky., writes that the following sidewalks are being paved with brick: Eighth street, from Harrison to Clay, one block, awarded to P. Halloran, at $1.15 per lineal foot on either side; Washington street, from Second to Third streets, one block, awarded to W. E. Allen, at $1.55 per lineal foot on either side; Norton street, from Third to Sixth streets, three blocks, awarded to W. E. Allen, at 95 cents per lineal foot on either side; Timble street, from Sixth street to Sixteenth street, nine blocks, awarded to W. E. Allen, at $1.05 per lineal foot; Jackson street, from Seventh street to Thirteenth street, six blocks, awarded to W. E. Allen, at $1.05 per lineal foot on either side.

S. H. Kimmel, city engineer, Henderson, Ky., writes that John Haffey was awarded the contract for 2,000 feet 8-foot brick sidewalk, 4-inch limestone curbing and 4-foot brick gutter on Third street from Green to Alvasia streets, price per lineal foot $1.07; and 1,000 lineal feet of 6-foot brick sidewalk, oak curbing, Alves street, from Second to Center streets at 26 cents per lineal foot; and Ed Marrion also received a contract for 400 lineal feet of 7-foot brick sidewalk, no curbing, at 25 cents per foot.

SEWERAGE.

About 8,000 feet of 12- to 8-inch pipe sewer will be built by the city of Haverhill, Mass.

Alexander Potter, of New York City, together with an able corps of assistants, has completed the plans for a complete sewerage system for Martin's Ferry, Ohio, estimated to cost $62,236.29.

A competition has been begun in Cadiz, Spain, to remain open until December 20, 1893, for the best plan for a proposed system of sewerage for that city, and offering $6,000 to the best author.

I. A. Correll, New Philadelphia, Ohio, writes that a system of sewerage has been adopted, the estimated cost of which is $40,000, and will sell bonds of that amount in payment therefor.

Work is being pushed on the construction of the Fort Plain, N. Y., sewers which are under the charge of De Witt C. Smith, chief engineer, assisted by H. A. Van Alstyne, engineer in charge of construction.

The sewer plans for Jefferson City, Mo., comprising one main sewer and seven district sewers, and at an estimated cost of about $30,000, have been completed, but the letting of the contract and construction has been postponed.

We are informed by J. Tudor Graves, city engineer of Fargo, N. D., that although the greater portion of that city has been reduced to ashes, he has been instructed to go ahead with the sewers already commenced, and he says that the city will be rebuilt at once, when all grades and street lines will probably be revised.

The city of Atlanta, Ga., is spending about $45,000 on brick or trunk sewers and $50,000 on lateral or street sewers this year. The latter sewers pay for themselves on the assessment being made against the abutting property. This is the largest amount of sewer work ever ordered done in the city in any one year.

CONTEMPLATED WORK.

We are informed that Iron River, Wis., contemplates extending its sewerage system.

Sewers are proposed for construction this year at Battle Creek, Mich., to cost over $30,000.

The question of a system of sewers is being agitated at Columbia, S. C.; Negaunee, Mich., and Winfield, Kan.

Norval W. Wall, Trinidad, Colo., writes that the city comtemplates extending its sewer system this season.

M. J. Blanding, Galesburg, Ill., writes that the city contemplates laying about five miles of vitrified pipe sewers from 12 to 24 inch.

Boone, Iowa, is considering the construction of a complete sewerage system, and has engaged Col. George E. Waring, Jr., to formulate a plan.

Plymouth, Mass., is contemplating the issuance of twenty thousand dollars in bonds to provide the main part of the town with a sewerage system.

The common council of Allegheny, Pa., is considering ordinances for ten lateral and five main sewers; also for the issue of sewer bonds for $300,000.

M. T. Dozer, Ashland, Wis., writes that Washburn, across the bay, contemplates building a system of sewers and doing considerable grading and other improvements.

The city of Ashland, Ky., contemplates building a sewer system and has invited John W. Hide, of Cincinnati, to visit the city and report on a system of sewerage and drainage.

Jos. M. Elford, Spartanburg, S. C., writes that the city council is discussing the sewerage question and a committee has been appointed to consult with competent engineers in regard to cost of same.

A committee has been appointed at Crawfordsville, Ind., consisting of the city engineer and three members of the council to report on a system of sewers for the city. A part of the system will probably be built this season.

James B. Gass, city engineer, writes that the sewer commissioners of Fort Smith, Ark., contemplate building a 600-foot extension to the storm sewer and attaching five catch basins thereto. The sewer will be of 24-inch vitrified pipe.

Chas. C. Brown, C. E., of Schenectady, N. Y., has been employed as consulting engineer, and with the city engineer will design a complete sewerage system, including both sanitary and storm water sewers for Frankfort, Ind. A part of the sanitary sewers will probably be put in this year.

CONTRACTS TO BE LET.

The city council of Brockton, Mass., has authorized a sewerage loan of $240,000.

The citizens of Auburn, Cal., voted to issue bonds for $20,000 for a sewerage system.

The citizens of South Milwaukee, Wis., have voted to construct a system of sewers.

It is reported that a system of sewerage will be built at Emporium, Pa., to cost $45,000.

City engineer, Kearney, Neb., writes that sewer extensions will probably be made this summer.

Edward Field, of St. Louis, Mo., has been directed to prepare plans for a system of sewerage for Belleville, Ill.

The proposed sewerage at Charlottesville, Va., is to be eighteen miles in length and plans are now being prepared.

Col. Geo. E. Waring has been employed by the city council of Boone, Iowa, to prepare plans for a system of sewers.

Plans, etc., have been prepared for a system of sewers at Redwood Falls, Minn., the estimated cost of which is $80,000.

The city engineer of Nashua, N. H., is preparing plans for a brick sewer, 28 inches to 30 by 45 inches, 3,500 feet in length.

Albert E. Andrews, Warren, Ohio, writes that the city voted in favor of issuing $20,000 in bonds for general sewer purposes.

Somerset, Pa., will have a system of sewerage, and L. W. Fogg, of Latrobe, has been employed to prepare plans and specifications.

Plans are being considered for a system of sewers for the east side of Des Moines, Iowa, size 48-inch double ring brick to 12-inch pipe.

C. E. Grunsky has prepared plans for a system of sewers for Salinas, Cal., including 10,300 feet of 14-inch and 8,000 feet of 16-inch pipe.

Bids will be received at the office of the city comptroller, Dayton, Ohio, until July 10, 1893, for furnishing materials and constructing sewers and appurtenances in sewer districts Nos. 2, 3, 4, 5 and 8.

A large amount of pipe and brick sewers has been recommended by the common council of South Bend, Ind. One sewer will be about a mile long.

The board of public works of Denver, Colo., has approved plans and estimates for three sewers to cost $118,680, $117,260 and $101,472, respectively.

The city engineer of Terre Haute, Ind., has ordered that surveys be prepared for a belt sewer to drain the east, southeast and northeast portions of the city. The estimated cost of the work is from $200,000 to $250,000.

We are informed that a sewerage commission, composed of Messrs. Pierson, Luckett, Noies, Stoddard and J. C. Boyd, city engineer, are considering a new sewerage system for Sacramento, Cal.

Bids will be received at No. 105 City Hall, clerk of the board of control, at Cleveland, Ohio, until July 5, for the construction of sewers in sundry streets.

Frank Place, Cortland, N. Y., writes that the sewerage commissioners have decided to construct about twelve miles of sewers, and have called a special election on July 6 to vote on same.

The city of South Bend, Ind., expect to do something this season in the line of sewerage. At the next meeting of the council a resolution will come up for about two miles of the Taylor street trunk sewer.

G. L. McKibben, city engineer, Van Wert, O., reports that surveys are being made for a sewer system at Delphos, O. The cost will be from $25,000 to $30,000. Estimates, plans and specifications will be ready during the next ten days.

Mr. Wm. M. Whitten, city engineer, South Bend., Ind., writes that the common council of that city at its meeting June 26 passed resolutions for 11,200 feet of sewers from 24 to 90 inches in diameter. Sealed bids will be received until July 24.

Sealed bids will be received at the office of the city clerk of Bradford, Pa., until July 3, for furnishing all material and labor and constructing 1,450 feet of 15-inch sewer, 1,876 feet of 12-inch sewer, 2,410 feet of 10-inch sewer, 7,000 feet of 8-inch sewer.

Bids will be received by the sewer commissioners of Amsterdam, N. Y., until July 6 for building 1,600 feet of 20-inch storm sewer on West Main, Pearl, Division and Market streets, together with the necessary man-holes and catch-basins. See Sealed Proposals.

Joseph W. Wilson writes that the town of Easthampton, Mass., has adopted a system of sewerage planned by McClintock & Woodfall, of Boston. An act authorizing the town to construct the same passed by the General Court of the State, and the contract for the same (or a part) has been let to Geo. M. Atkin & Co., of Palmer, who will immediately commence on the same.

Sealed proposals will be received by the board of sewer commissioners of the village of Ilion, N. Y., until July 6, 1893, at noon, for the construction of a sewerage system for said village, consisting of furnishing and laying about 10.6 miles of vitrified sewer pipe, with its branches, and the construction of about 109 manholes, 78 lampholes, 40 flush tanks, and other appurtenances.

Sealed bids will be received at Room 7, Sanford Homestead Building, Amsterdam, N. Y., until July 6, 1893, for furnishing all materials and constructing complete about 1,600 feet of 20-inch storm sewer on West Main, Pearl, Division and Market streets, together with the necessary manholes and catch basins.

CONTRACTS AWARDED.

F. E. Alexander & Co. has been awarded the contract for a system of sewers at Fort Worth, Texas.

The contract has been awarded for furnishing and laying 5,000 feet of 18-inch sewer pipe at Goshen, Ind.

The contract for the Gooseneck Creek sewer at Kansas City, Mo., has been awarded to Cotter, McDonnell & Co., at $77,896.

Richard Strout, city engineer, Emporia, Kan., writes that contracts have been awarded for the construction of over 7,000 feet of sanitary sewer.

A contract for about two miles of 24-inch tile sewers has been awarded at Seymour, Ind., at $18,500. M. J. Bannard, Louisville, Ky., received the contract.

Jones & Meehan, Jamaica Plains, N. Y., were awarded the contracts for sections 30 and 44 of the main sewer, Boston, Mass., at $53,589 and $33,330, respectively.

City engineer of Seymour writes that the contract to build a sewer 14,120 feet long, at a cost of $18,500, has been awarded to M. J. Bannen, of Louisville, Ky.

A contract for fourteen miles of sewers to drain the west and northwest part of the city of Des Moines, Iowa, has been awarded to Bryan & Youngerman, at about $132,000.

John G. Lane, city engineer, Escanaba, Mich., writes that J. B. Moran will construct 2,500 feet of 8-inch sewer in that city this season. The contract was let last year.

Fred E. Avery, Watertown, N. Y., writes that Scripture & Morris were awarded the contracts for sewers to be built in Null and Pearl streets at a bid of $7,812.60 and $7,736.99 respectively.

F. R. Lockling, of Hannibal, Mo., writes that sewer districts 3 and 4 are about completed, the sewers were constructed of 8 and 12-inch pipe, and that districts 6 and 39 are under contract.

S. H. Kimmel, Henderson, Ky., reports that John Haffey has the contract for 500 lineal feet of 5x3.5 brick sewer on Ingram street, between Center and Washington streets; price, $1.90 per lineal foot.

W. C. Teller, Iron Mountain, Mich., writes that H. C. Foley, of Menominee, Mich., has the contract for about 1½ miles of lateral sewers; 8, 12 and 15-inch salt-glazed vitrified pipe will be used, and will cost $5,838.44.

G. W. Tillson has been let the contract to lay 2,000 feet of 12-inch sanitary pipe sewer at South Omaha, Neb. Also Stinson & Hube have been awarded contracts for 24-inch and 12-inch sewers, with necessary manholes and catch basins.

Udo Hesse, Saginaw, Mich., writes that the following sewer contracts have recently been let in that city: Bristol and Harrison streets, from Saginaw river to Houghton avenue, with outlet into Saginaw river, Geo. Davies, $12,035.65; State street, from Olney to Mershon streets, J. C. Davies, $6,227.90; Hess street, from Jefferson to Sheridan avenues, Alfred Davies, $4,431.20; Mackinaw street, from Mason to Bates streets, D. A. Lamson, $2,648.50; Johnson street, from Sixth street to east city line, J. C. Davies, $2,848.65; Fayette street, from State street to Houghton avenue, Alfred Davies, $1,542.40; Tenth street, from Walnut to Ainesly streets, W. A. Armstrong, $827.60. Several other smaller contracts were also let, amounting to about $2,500.

H. H. Goss, Brockton, Mass., favored us with canvas sheets of bids on sections 1, 4, 5 and 6 of the Broctown sewerage system which show the estimated quantities of excavation, rubble masonry, brick masonry, concrete, distributing pipe, etc., by the different bidders who were on section 1: D. J. Cronin, T. F. Maney & Co., F. H. Blaisdell and Jones & Meehan; D. J. Cronin was awarded the contract. Section 4: Frederick E. Shaw, Charles H. Eglee, Frank L. Allen, T. F. Maney & Co., Moulton & O'Mahoney, D. J. Cronin and Moore & Co.; Moore & Co. were awarded the contract. Section 5: National Construction Co., Chas. McDermott, Jones & Meehan, Troy Public Works Co., Everson & Liddle, G. C. Luther, H. P. Nawn, F. E. Shaw, T. F. Maney & Co., D. J. Cronin and Moulton & O'Mahoney; Chas. McDermott was awarded the contract. Section 6: Moulton & O'Mahoney, Everson & Liddle, Dennis O'Connell, National Construction Co., Jones & Meehan, T. F. Maney, O'Conner & White, and A. W. Bryne; Moulton & O'Mahoney were awarded the contract.

WATER-WORKS.

Water-works are badly needed at Platteville, Wis.

The laying of the new water mains to replace the old cement ones at Schenectady, N. Y., is well under way. Of about six miles which are to be laid about one mile is laid.

Mr. Alexander Potter, of New York City, has been engaged to design and superintend the construction of a system of water supply for Sistersville, W. Va. The supply will be taken from the Ohio river.

The following cities are agitating the water-works question: Pierson, Ia.; Clayville, Pa.; Titusville, Florida; Perry, Ga.; Wapakoneta, O.; Winton Place, O.; Newton, N. J.; Mingo, Ohio; Eureka, S. Dak. and Dunlap, Iowa.

Marshall, Mich., is engaged in a water war. The water-works company, which several years ago was given the contract for supplying the city with water, has become unsatisfactory. Steps are being taken to render the contract null and void.

CONTRACTS TO BE LET.

It is reported that a system of water-works will be put in at Frankfort, N. Y.

It is reported that the mayor of Kenosha, Wis., is preparing plans by which the town can build and own its own water-works.

John W. Hill, consulting engineer, Cincinnati, Ohio, has been engaged to report on a system of water-works for Lebanon, Ind.

The water board of Detroit, Mich., held a meeting recently, and granted petitions for water mains on twenty-two streets and alleys.

The board of public works of Jamestown, N. Y., has recommended that the city build water-works; estimated cost, $250,000.

The town of Bad Axe, Mich., voted $16,000 at a special election, held for that purpose, for the construction of a water-works system.

L. L. Beall, city engineer, Cumberland, Md., writes that that city will relay its water mains this summer, using about 12 miles of pipe.

The committee on water-works of Frankfort, N. Y., have submitted the engineer's report for a gravity system of water-works, at an estimated cost of $43,000.

Improvements and extensions will be made to the water-works system at Fall River, Mass. The city treasurer has been authorized to negotiate a loan of $75,000 for same.

Sealed bids will be received at the office of J. M. Lee, city clerk, Greenville, Miss., until August 1 for construction of water-works, with or without sewerage, under a franchise of thirty years, to be owned by the city. Plans and specifications on file in the clerk's office.

Water-works are to be built at Meredith, N. H.; Fairport, N. Y.; Frankfort, N. Y.; Hillburn, N. Y.; Sufferin, N. Y.; Washington, N. Y.; Fairchance, Pa.; Gardeau, Pa.; Quincy, Fla.; Duquoin, Ill.; Vallejo, Cal.; Ottawa, Ill.; Madison, Fla.; St. John, Kan.; Sistersville, W. Va.; Eastman, Tex.; McKee's Rock, Pa., and Crystal Falls, Mich.

Improvements and extensions will be made to the water-works system at Chicopee, Mass.; Great Barrington, Mass.; New Bedford, Mass.; Fall River, Mass.; Waltham, Mass.; Newburg, N. Y.; Hanover, Pa.; Norwood, Ohio; Waukegan, Ill.; Galesburg, Ill.; Beatrice, Neb.; Milwaukee, Wis.; Bradford, Pa.; Cumberland, Md.; Cincinnati, Ohio; Granite Falls, Minn., and North Platte, Neb.

Plans have been prepared for increased storage capacity on Price Hill, a suburb of Cincinnati, Ohio. It is estimated that a masonry reservoir would cost $150,000, or $258,000 for a capacity of 5,000,000 or 7,800,000 gallons, respectively, and that four tanks, 30 feet in diameter, would cost $42,000 or $62,000 for capacity of 425,000 or 648,000 gallons, respectively. It is reported that the plans for four tanks of 684,000 gallons capacity have been recommended for acceptance.

CONTRACTS AWARDED.

Henry R. Worthington, New York City, has been awarded the contract for two 3,000,000-gallon high duty pumping engines for the extensions and improvements of the water-works system at Manchester, N. H.

A franchise has been granted to the Michigan Pipe Co., Bay City, Mich., for the construction of a water-works plant at Cripple Creek, Colo., to cost $75,000, 85 hydrants being required. The supply will be obtained from West Beaver Creek.

Thatcher & Bremer, of Toledo, Ohio, have been awarded a contract at their bid of $39,600 for furnishing everything and laying the pipe extensions, constructing the crib and making the well, to the water-works system at Dunkirk, N. Y.

Fred H. Pickles, city engineer, Winona, Minn., writes Fred Youngreen, of Minneapolis, has been awarded the contract for laying three miles of water mains from 4 to 30 inches in size. The contract amounts to $7,000. The Addyston Pipe and Steel Co., of Cincinnati, have the contract for furnishing the pipe, 550 tons at $25.65 per ton. The Winona Mnfg. Co. will furnish the specials, about 15 tons.

BRIDGES.

An iron, low-truss, swing bridge will be built at Ottawa, Ill.

The citizens of Frankenmuth, Mich., will build a new $8,000 bridge over the Cass river.

An iron bridge, to cost $5,700, will be built over the Guadaloupe river, at Thomaston, Tex.

Plans have been prepared for a bridge over Blackbird creek, at Townsend, Del., to cost about $4,000.

An endeavor is being made at Rochester, N. Y., to secure the construction of a new bridge over the Erie canal at West avenue.

The commissioners of Morris and Somerset counties, N. J., have decided to build a new bridge across the Passaic river at Sterling, N. J.

Bids will be received by S. Craig, Wapakoneta, Ohio, until July 6th, for constructing masonry culverts and bridges on the River Road pike.

The commissioners of Madison county, Ind., have ordered the erection of six new bridges in that county, for which $50,000 in bridge bonds will be issued.

The city of Woonsocket, R. I., has voted to build an iron bridge from Main street across the Blackstone river to Hamlet avenue. Estimated cost, $100,000.

Sealed proposals will be received until July 8, 1893, at the city clerk's office, Delaware, Ohio, for the construction of a single span Pratt truss bridge 218 feet long.

J. W. Strack, C. E., Spokane, Wash., writes that the contract has been let for a steel bridge 400 feet long, to be built at Olive street at a cost of about $23,000.

L. B. McCabe & Bros. were awarded the contract for the construction of a stone and brick bridge on North avenue, across Jones' Falls, Baltimore, Md., in consideration of $319,915.

John Hagerty, county auditor of Hamilton county, Ohio, will receive sealed proposals until July 12, for constructing a wrought iron truss bridge over Blue Rock creek, Colerain township.

Henry Kelling, Walla Walla, Wash., writes that James Knott has been awarded the contract to build a double-stone arch bridge over Mill creek, at East Main street crossing. Plans and specifications were prepared by E. S. Clark.

Sealed bids will be received by Edwin F. Bishop, Room 1, City and County Hall, Buffalo, N. Y., until July 6, 1893, for constructing an iron bridge on Hager street over Scajaquada creek, and for a bridge on Girder street over Scajaquada creek.

The site for the bridge over the Mississippi at New Orleans has been selected by the bridge company and approved by the war department. It is a little above what is known as Twelve Mile Point, or five miles above the upper limits of the city.

A bridge company has been organized at Avalon, Md., by Charles Marshall, Richard Cromwell and others, to be known as the Elk Ridge Bridge Company. It will build a toll bridge across the Palapsco river between Avalon and the Thomas viaduct at a cost of $65,000.

A. H. Davidson, Augusta, Ga., writes that contracts have been let for two bridges in that city. A bridge on Tenth street, to cost, including abutments and retaining walls, $8,808.12, and a bridge on Broad street to span Hawk's gulley, to cost, including abutments and retaining walls, $8,979.50.

The Columbia river is being spanned at Wanatchee, Wash., by a cantilever bridge 916½ feet long and 120 feet above low water and 70 feet above extreme high water. The entire bridge is built of steel and wrought-iron, and the completion of it will mark the accomplishment of the greatest feat of railroad engineering in the west.

Sealed bids will be received by the city comptroller, Dayton, Ohio, until July 5th, for removing the bridge across the basin extension canal at Second street, and building the following bridges: A wrought iron whipple-truss bridge across Wolf creek at Broadway; an iron hoist bridge across the Miami canal at Main street; an iron hoist bridge across the basin extension canal at Second street and also one at First street.

The board of commissioners of Evansville, Ind., will receive sealed bids until July 15th for furnishing labor and material and erecting two stone abutments for a bridge across Pigeon creek at Franklin street, that city. Also for furnishing and erecting the iron superstructure for a highway bridge over Pigeon creek at Franklin street. Plans and specifications on file in the office of county auditor.

STREET LIGHTING.

Electric lights are badly needed at Platteville, Wis.

Electricity will light the streets of New Castle, Col.

An electric light company is being formed at McDonald, Pa.

The city of Adrian, Minn., has voted in favor of bonding that place for the construction of a system of electric lights.

Madison, Me., has voted to build an electric light plant and secure a water power to operate it. A loan of $15,000 has been authorized.

Carthage, N. Y., has contracted with the American Electric Light Co., of that place, to light the streets for five years at $60 per lamp per year.

Detroit, Mich., has at last decided to build a municipal electric lighting plant, and bonds to the value of $600,000 have been authorized to pay for them.

Bids will be received by the city clerk of Tiffin, Ohio, up to noon July 7, for lighting the streets and alleys for a period of five years with electric lights to burn all night.

F. R. Dougherty, Eau Claire, Wis., writes that the city council of Eau Claire has accepted the proposal of the Eau Claire Lighting and Telephone Co. for lighting the city.

Sealed proposals will be received until July 6 by the city clerk of Ludlow, Ky., for lighting the city by electricity in accordance with ordinances and specifications adopted.

Sealed bids are invited by the city clerk of Ionia, Mich., until July 10, for lighting the city for a period of ten years. Bids not confined to any kind or system of lighting. Fred Cutler, Jr., city clerk.

About 300 arc lamps of various powers are being erected to light the principal streets of Munich. The town hall will also be illuminated by 1,800 glow lamps of 16 C. P. Water power is to be used.

The new contract between the city of Manchester, N. H., and the Electric Light Company for lighting the city streets is for ten years, and will result in a saving of $60,000 as compared with the former contract price.

Robert P. Woods, city Engineer, Wabash, Ind., writes that the Wabash Electric Light Company has contracted to light the city for five years. The company is putting up an additional building and will spend $15,000 on their plant.

Los Angeles and San Francisco capitalists are the projectors of an enterprise to establish at Monrovia, Cal., an electric light plant that will be run by water power from the Saw Pet Canyon, just north of Monrovia. It will supply the adjoining towns of Sierra Madre, Duarte, Santa Anita and El Monte with light, and run a motor railway between Los Angeles, Pasadena and Monrovia.

The following cities are to be lighted by electricity: Rochelle, Ill.; Milford, Ill.; Kyle, Hays county, Tex.; Ramapo and Hillburn, N. Y.; Madison, Me.; St. Genevieve, Mo.; Lambertsville, N. J.; Walden, N. Y.; Port Washington, Wis.; Effingham, Ill.; Valley City, N. D.; Pulaski, N. Y.; Eau Claire, Wis.; Branchville, N. J.; Paw Paw, Mich.; New Castle, Colo.; Belle Plaine, Iowa; Eastland, Cal.; North Platte, Neb.

PUBLIC PARKS.

Fort Wayne, Ind., is to have a handsome new park.

A new public park is among the possibilities for Columbus, Ind., in the near future.

Steps are being taken at Denver, Colo., to establish a general and permanent park system for that city.

STREET RAILWAYS.

Crawfordsville, Ill., will have an electric street car line.

An electric road is proposed to be built in Tewksbury, Mass.

Lowell and Lawrence, Mass., are to be connected by an electric railway.

An electric railway is now running between Johnstown and Gloversville, N. Y.

It is reported that Toledo and Detroit are to be connected by an electric railway.

Electricity will be used as the motive power in the street railways of Dayton, O.

The city of Roanoke, Va., has nearly twenty-one miles of electric street railway in operation.

A company has been organized to build an electric railway from New Castle to Knightstown, Ind.

The Charleston (W. Va.) Street Railway Company has obtained a franchise for an electric street railway line.

The Alton Park and Land Co. is going to build an electric railroad from Chattanooga, Tenn., to Alton Park.

It is reported that an electric belt line will be built at Trenton, N. J., which will encircle the city and suburbs.

A forty year franchise has been granted to the railway company at Charleston, W. Va., to construct an electric line.

A new company has been incorporated with a capital of $42,000 at Towanda, Pa., known as the Towanda Traction Co.

F. B. Enslow has applied to the city council for the right to build an electric railway system in Charleston, W. Va.

The trustees of Geneva, N. Y., have finally granted a franchise for the building of an electric street railroad in that village.

The Charleston (W. Va.) Street Railway Co. will begin building its electric line within fifteen days. The route is five miles long.

The Amsterdam Street Railroad Co. has been granted a franchise and will extend their road from Amsterdam, N. Y., to Fort Johnson.

The Frederick and Middletown Valley Railroad has been granted a franchise for an electric railway in specified streets in Frederick, Md.

The Pleasure Resort Ry. Co. has been incorporated at Denver, Colo., to build an electric line to North Denver, and to Rocky Mountain and Berkeley lakes; capital stock, $100,000.

The common council of Adrian, Mich., has been asked for right of way for an electric railway to be built between that city and Tecumseh.

Ike Hayne, of Jackson, and W. R. Gravely, of New Orleans, have been granted a franchise to build an electric street railway in Jackson, Miss.

A company has been formed at Marion, Ind., for the purpose of constructing an electric railroad from Marion to Hartford City and points in Wells county.

The Union Electric Railway Company, of New York City, has completed arrangements whereby it becomes the possessor of the entire lines of the Westchester Co.

The Indiana Electric Power Company, Goshen, Ind., has been incorporated to construct, maintain and operate electric street railways, etc.; capital stock, $300,000.

Luther Dean, of Taunton, Mass., writes that the Taunton Street Railway Company has received a franchise for an electric line from Taunton to Slade's Ferry Bridge, Fall River, through Dighton and Somerset. The power station is now being erected at Taunton.

The franchise for an electric road between Toledo and Maumee, Ohio, eleven miles, has been awarded to A. E. Lang, representing the Toledo Consolidated Street Railway Company. He agrees to have the road completed by September 1st, and the fare to be charged for the entire distance is three cents.

James B. Gass, city engineer, writes that the city council of Fort Smith, Ark., is considering an application from a Cleveland, Ohio, firm for an electric street railway and light franchise. In case the franchise is granted, the electric company will purchase the horse car lines, put in standard gauge tracks, and extend the system.

A company composed of capitalists from Dayton, St. Louis, Chicago, Philadelphia and London, Eng., has been organized with a capital of $4,500,000. The purpose of the new company is to connect Indianapolis, Noblesville, Muncie, Anderson, Elwood, Tipton, Kokomo, Frankfort, Marion, Peru, Logansport, Lafayette and Fort Wayne with electric car lines. It is to be known as the Central Indiana Electric Railway Company.

MUNICIPAL BONDS.

T. J. Dowell, San Diego, Cal., invites bids until July 5, for the purchase of $380,000 of 4½ per cent. bonds.

The city corporation clerk of New Philadelphia, Ohio, will, on July 10, 1893, receive sealed bids for the sale of $14,000 six per cent. general improvement bonds of said village.